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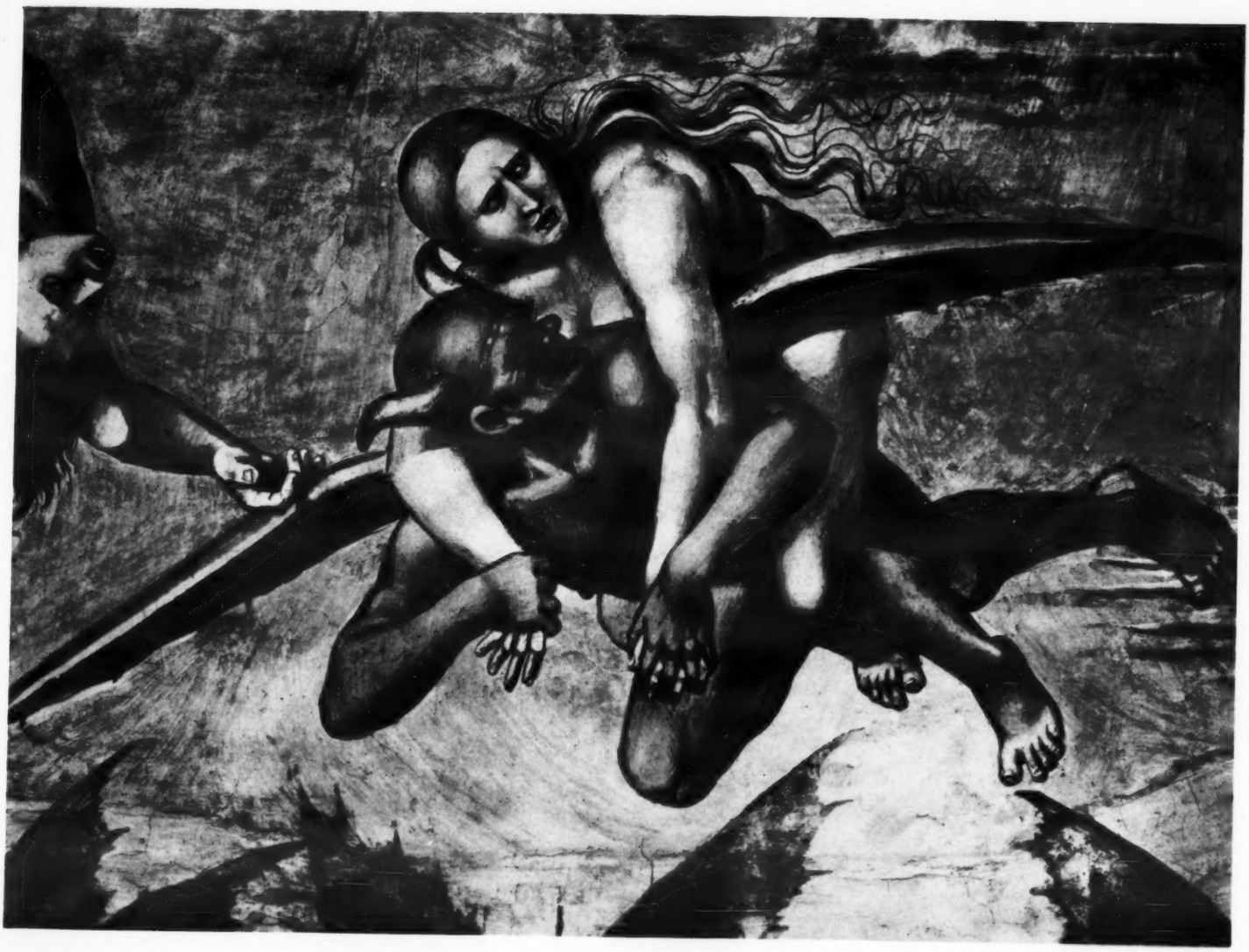
REVIEW OF WORLD AVIATION



IN THIS ISSUE:

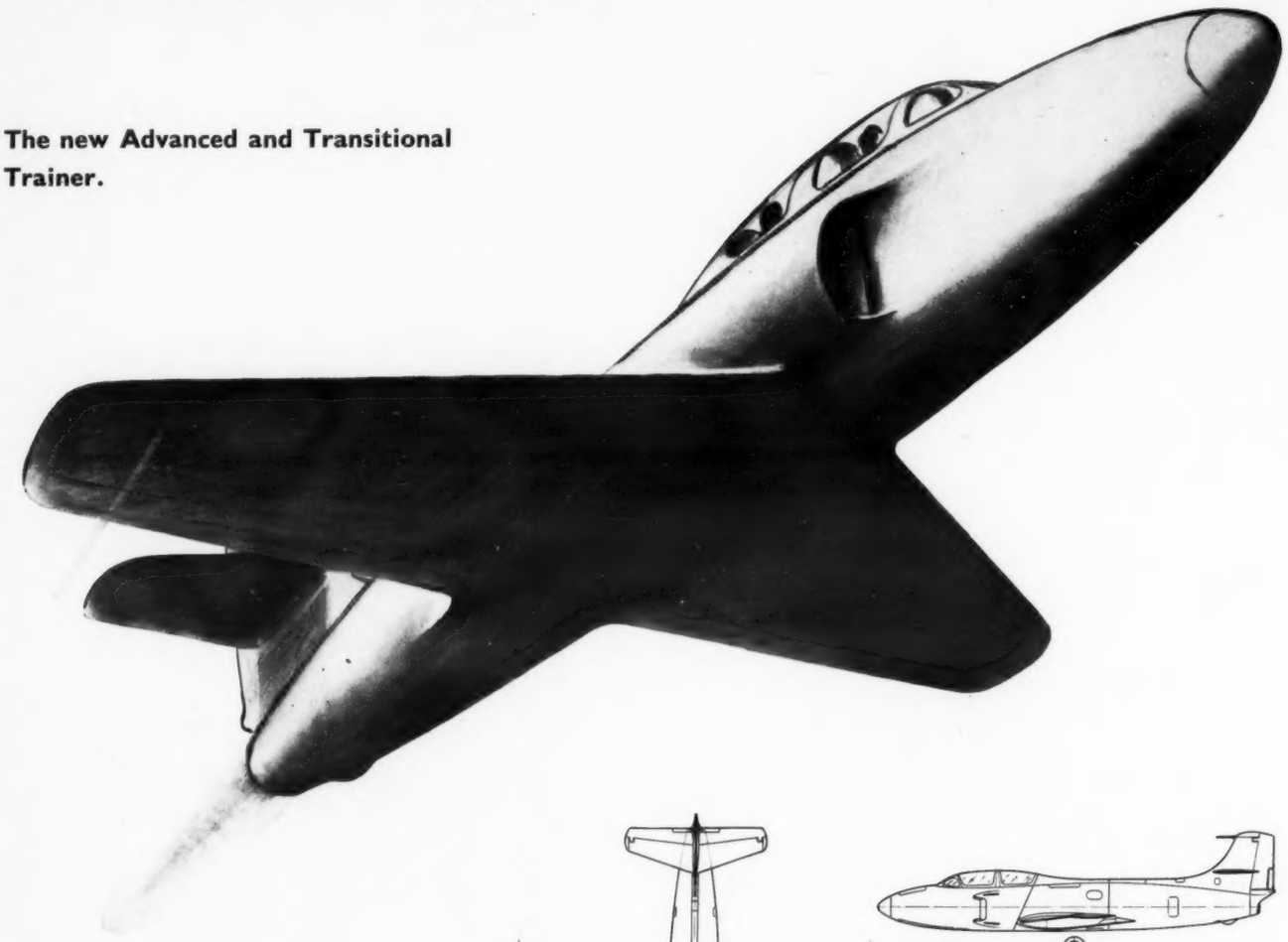
Italian Wings

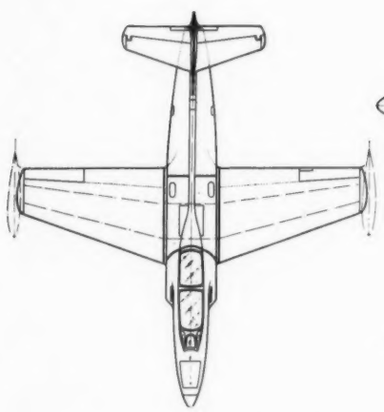
VOLUME V 6 1950

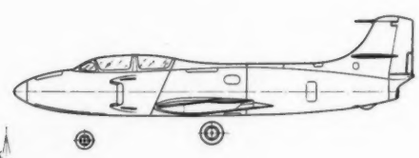
FIAT G 80

De Havilland "Goblin 35" Turbojet

The new Advanced and Transitional Trainer.







All-metal low-wing monoplane, two seats in tandem, dual controls.

All-up weight	11,000 lbs.	Time to climb to 20,000 ft.	4 min. 50 sec.
Maximum speed at sea level	557 m.p.h.	Service ceiling	44,500 ft.
Maximum rate of climb	5,100 ft./min.	Maximum range at 30,000 ft. with 2,200 lbs. of fuel	840 miles

Designs for an alternative version powered with the Rolls-Royce "Nene" turbojet have been completed

INTERAVIA

Review of World Aviation

Volume V — No 6 — 1950

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Front cover :

The Italians have been aviation visionaries for centuries. Picture shows a detail of the mural painted from 1499 to 1509 in the Cappella della Madonna of Orvieto Cathedral by Luca Signorelli, pastmaster of the Umbrian school (1450-1523).

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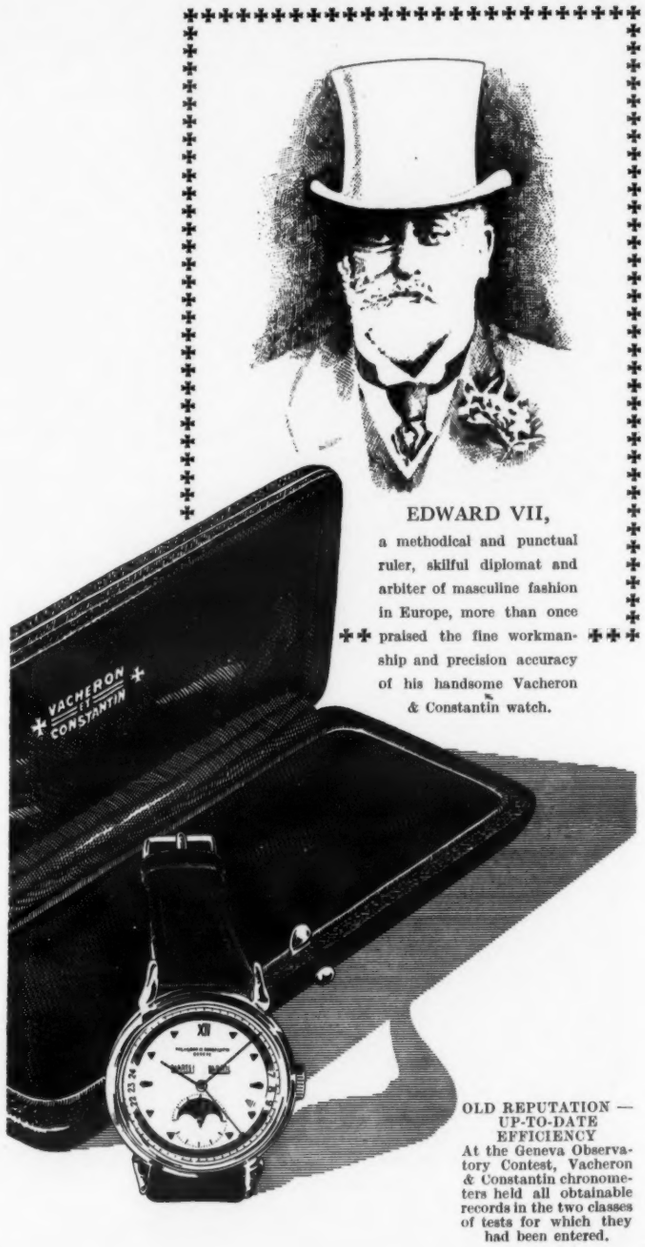

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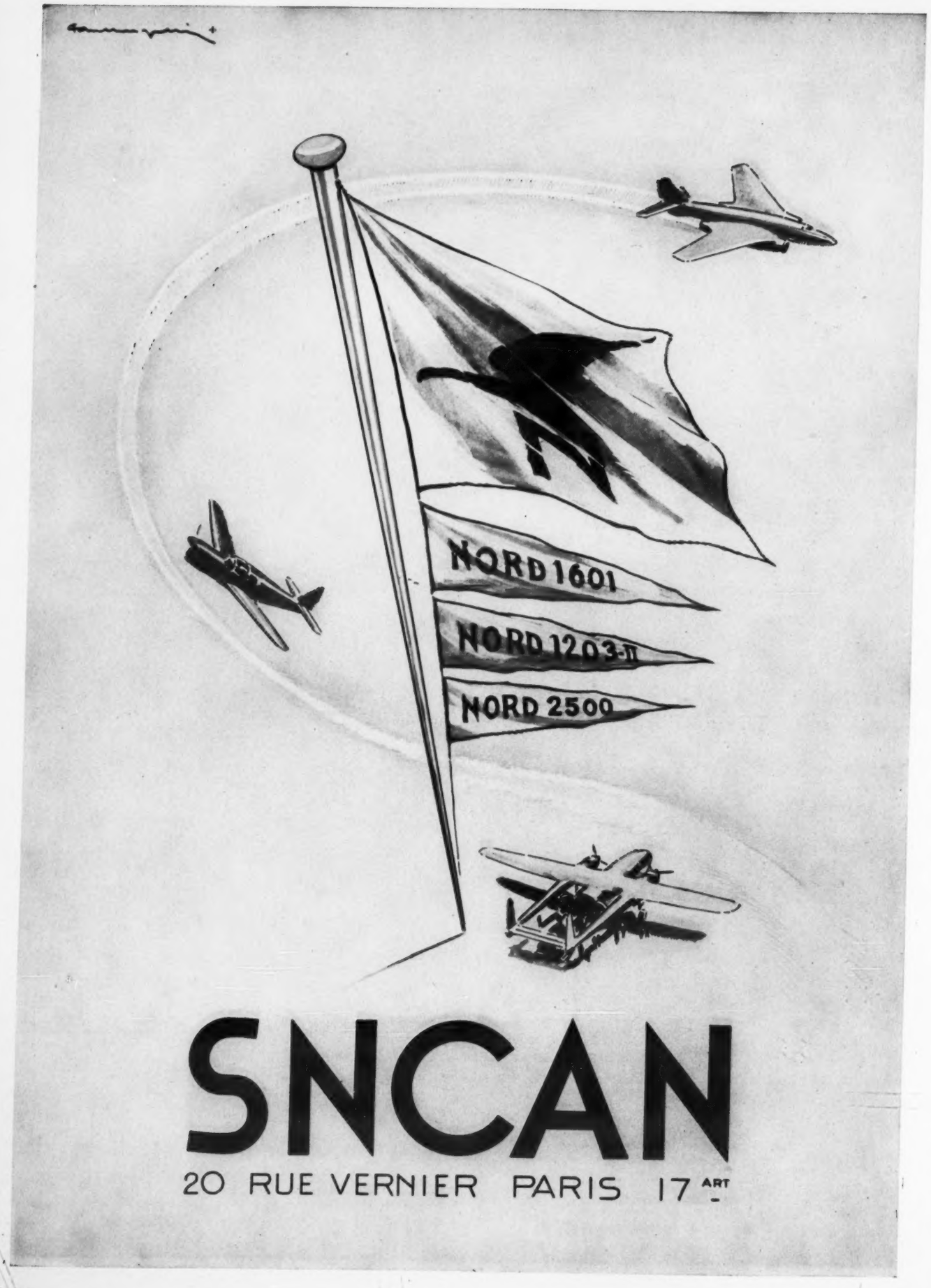
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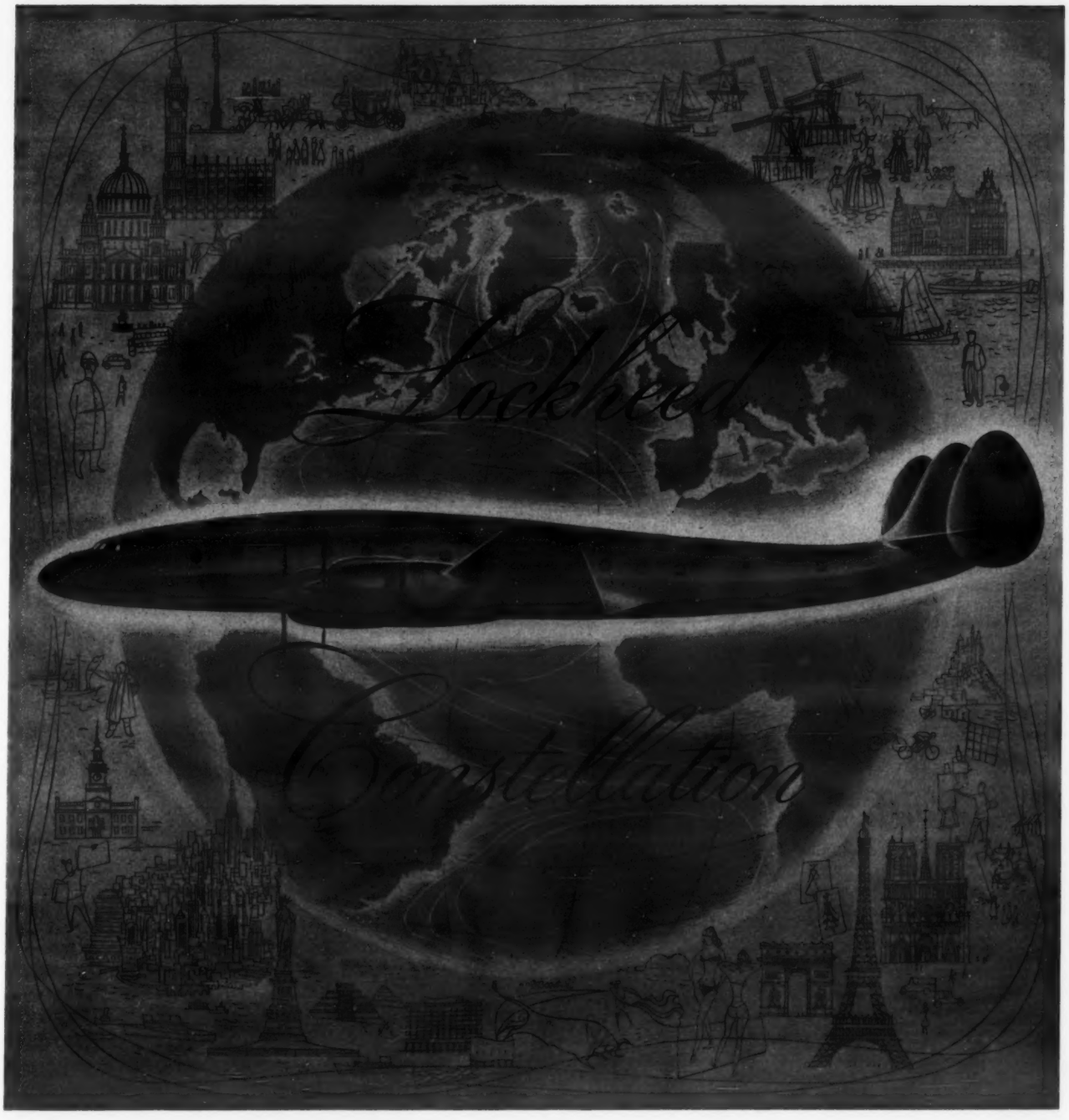

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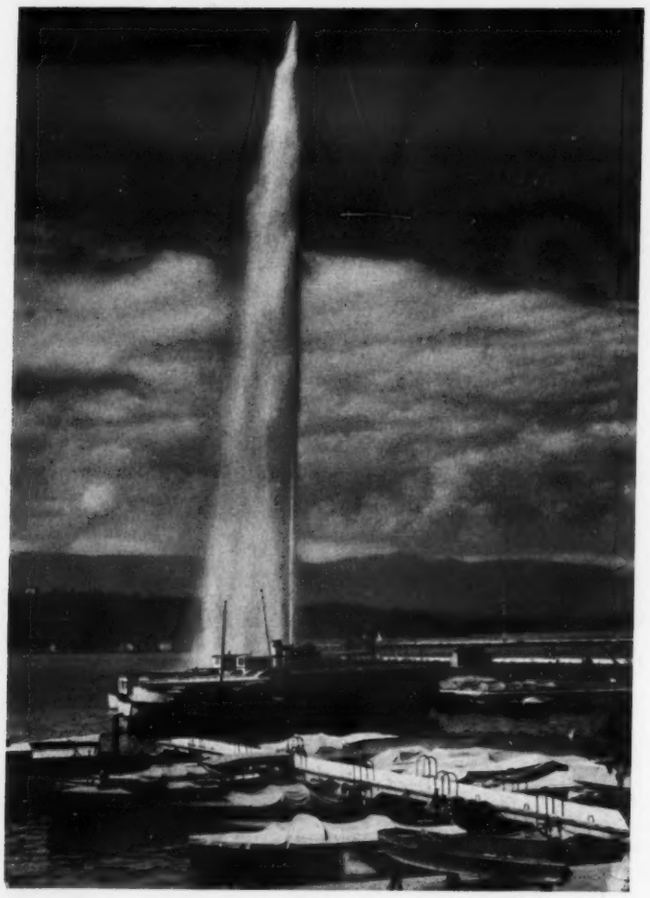

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The Legacy of Leonardo da Vinci

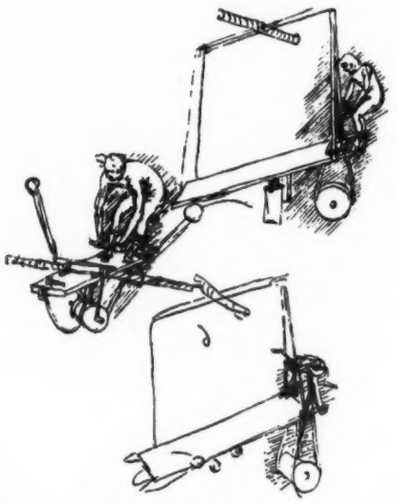
A Brief History of Italian Aviation

BY GIORGIO LOURIER, ROME

Human flight, fruit of man's instinct and mind, can be traced back in Italy to the dawn of the Renaissance. Leonardo da Vinci made a careful study of the bird's faculty of flying into the wind, of soaring with "motionless wings," before he engaged in lengthy calculations of the principle of flying *with* the wind.

Leonardo da Vinci, "the illiterate yokel," as he liked to refer to himself, the "King of Obscure Realms," as Gabriele d'Annunzio described him four centuries later, gathered the results of his researches into the phenomenon of bird flight in his "Codice Atlantico" and other works from 1486 to 1490. He conceived the idea of building a machine with mobile wings which would be set in motion by human muscle power. Ten years later, he envisioned the idea of "aerodynamic lift." The devices he drew in the "Codice" have either rigid, flapping and even rotating wings, like modern helicopters.

Back to Leonardo da Vinci's time dates the activity of a Perugian, Gian Battista Danti, who lived from 1478 to 1577 and who may have been a disciple of the great Leonardo : he tried to fly across Lake Trasimenus, West of Perugia. That the world was haunted by the idea of human flight is shown by the fact yet another inventor of the same period, Paolo Guidotti, of Lucca, is said to have flown a quarter of a mile using parachute-like wings. He ended up on a roof with a broken hip. A century later, Tito Livio Barattini, physician and mathematician of renown, built a sort of kite. In 1670 the Jesuit Father Francesco Lana Terzi, of Brescia, devoted part of his work to certain new inventions and to a "ship which sails on the air," thus accomplishing in the field of lighter-than-air ships what Leonardo da Vinci had achieved in the heavier-than-air domain.

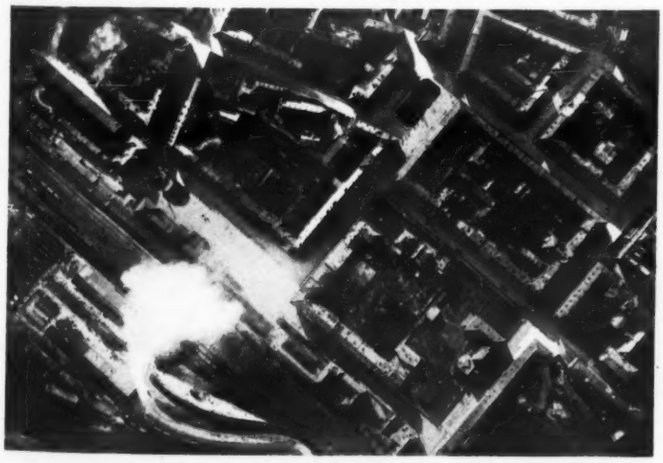


1486 : Leonardo da Vinci made these sketches to illustrate his ideas for the construction of a flying machine powered by human muscular energy.

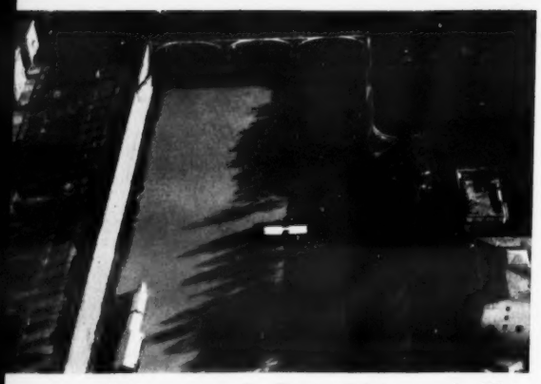
There is one curious statement which might easily have been pronounced in modern times : Leonardo da Vinci's ideas, sifted by Father Lana, caused the Marquis d'Argenson—Minister of Louis XV—to write his famous memoirs on researches conducted in Italy. He says : "We shall have air forces... A new post will have to be created in the Kingdom, that of Secretary of State for Air..."

On March 3rd, 1784, Paolo Andreani succeeded in accomplishing the first balloon ascent, followed in the same century by Vincenzo Lunardi and Francesco Zamboccari. On November 6th, 1884, the Italian army

1918 : Gabriele d'Annunzio's "Serenissima" squadron dropped pamphlets on Vienna during World War I—a foretaste of the 1939-40 "phoney war."



1924 : The British Air Minister, Sir Samuel Hoare (now Lord Templewood), at Montecelio. *Left to right :* General Rodolfo Verduzio, Chief of the Italian Air Force Technical Command ; Sir Samuel Hoare ; Major Giuseppe Macerafini ; General Alberto Bonzani, Under-secretary of State for Air ; and (foreground) Mario de Bernardi, head of the Montecelio flight test centre.



1925 : Francesco De Pinedo alighting on the Tiber, Rome, after a 30,000-mile flight from Italy to Australia and Japan and return. The aircraft was a Savoia 16-ter single-engine flying-boat.

1925 : Mussolini, who had not yet developed his taste for uniforms, at Centocello, with Generals Verduzio, Piccio, Cappuzzo and Bonzani.

constituted a corps of balloonists. Three years later Enrico Forlanini's helicopter made its first flight at Milan.

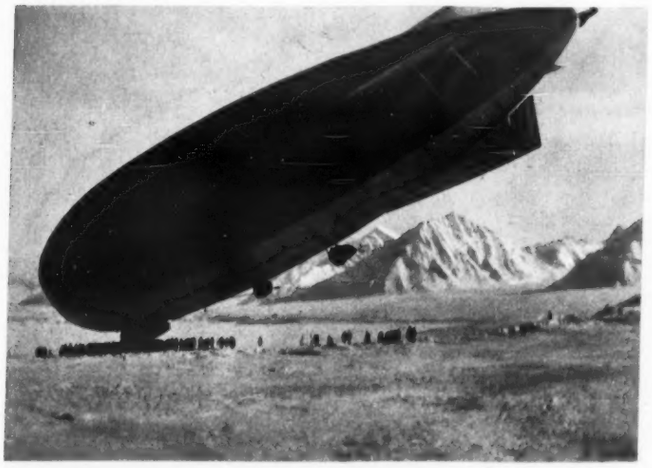
The early twentieth century saw the same Forlanini, Celestino Usuelli and others starting to build lighter-than-air craft. Incidentally, lighter-than-air craft became part of military strategy immediately after 1888 : the Italian army utilized balloons for observation purposes in the Tigré area during the Ethiopian war.

On May 1st, 1909, Mario Calderara flew an "aeroplane" to Centocelle, with a passenger. In November of the same year, the first international aviation exhibition was held in Milan. The following year Calderara opened the first pilot training school and the SPA company, of Turin, built an aircraft to the designs of Faccioli. On March 17th, 1910, the State set up the *Ufficio Superiore dei Servizi Aeronautici ;* Caproni entrusted his "test pilot" Tabacchi with his first monoplane ; pilot Umberto Savoia—now President of the *Associazione dei Pionieri del Volo* (Association of Italian Air Pioneers)—accomplished the first cross-country flight, from Centocelle to Vigna di Valle, in 31 minutes, and followed up this feat by making the first flight over Rome. The year ended with the endurance record of Stefano Amerigo who remained in the air for 3 hours 19 minutes 39 seconds with a passenger. Commercial aviation started in 1911 : the first civil transport flying school was opened and an air mail service established between Venice and Bologna. At the same time aeroplanes were used for military purposes : after taking part in field manœuvres, a first squadron was transferred to Tripolitania where for the first time in history aircraft went into action. Italians used them against the Turks for observation patrols and offensive missions. They were also used in psychological warfare and dropped leaflets addressed to the population (the first instance of propaganda war !). In 1912, in Libya, the first dirigible balloons, "P.2" and "P.3," went into action. During the same year, on June 28th, November 19th and 28th respectively, the Government formed the first *battaglione aviatori* (air battalion) and the "servizio d'aviazione coloniale" (Colonial Air Service) and decided to set up an Italian Military Air Service. In 1913 the first hydroplane training centre was opened in Venice ; a world distance record was established by Clerici with 500 km (310 miles) ; De Carolis set up an altitude record with 2700 m (8,850 ft.) which a year later was beaten by Oreste Salomone who reached 4700 m (15,400 ft.).

In 1915 Italy entered into World War I : on January 7th the *Corpo Aeronautico Militare* was constituted and on May 13th the *Servizi dell'Aeronautica* started to function. These air forces comprised 89 aircraft and 72 pilots ; on November 4th, 1918, at the close of hostilities, Italy possessed 1778 aircraft, 22 dirigibles and 32 companies of aviation personnel. Aircraft equipment, armament and ammunition

This time in full regalia, Mussolini attends the inauguration of the new Air Ministry in Rome, accompanied by representatives of the Fascist and military authorities. The second man from the left is an extremely impressive military figure . . .

1926 : The first airship of General Umberto Nobile, used for flights to the Polar region. The second airship crashed in the Arctic in 1928. General Nobile abandoned his crew, and the resulting investigation ended in the General's dismissal from the Italian Air Force. After that, Nobile spent a considerable amount of time in the Soviet Union and in Brazil. He was reinstated after the war.



1928 : Umberto Maddalena (left) and Stefano Cagna on the wing of their Savoia S.M.55 with which they crossed the Arctic Circle to bring aid to the airship "N. 2."

1928 : The Savoia S.M.64 of Del Prete and Ferrarin on the beach of Villa de Touros, Brazil, after establishing a new long distance record of 4,763 miles (7,666 km).

were predominantly Italian-made (SVA, Caproni, SALM, SIA, FBA). A total of 73 aircraft factories had worked for the Allies. In 3 years' time 20,000 aeroplanes and seaplanes and 35,000 power plants were built. The Air Force budget rose from 17,000,000 lire in 1915 to 600,000,000 lire in 1918.

Italian aeronautics had successfully tried to honour the legacy left by Leonardo da Vinci, and it will be agreed that Italy's airmen were guided by natural instinct and logic. In the war against the Central Powers they learned that the primary prerequisites of success were psychological aptitude and precise technical thinking. And there was no lack of enthusiasm.

The impersonation of the first of these essentials was Gabriele d'Annunzio, whose audaciousness fired his "soldiers of the sky" to carry out a feat which he had long planned, namely, the longest formation flight of the time. On August 9th, 1918, seven SVA aircraft of the *La Serenissima* squadron carried a "message of peace" to the people of Vienna and thus contributed to the downfall of the Dual Monarchy. D'Annunzio's galvanizing personality found its opposite number in Eugenio Chiesa, Deputy to Parliament, who headed the air force procurement and supply organization.

Political events after World War I caused a rapid collapse of Italy's air power. From

1929 : Thirty-five flying-boats under the command of General Italo Balbo flew to Odessa before landing on Lake Hajibaysky, in the Ukraine. Picture shows some of the crews after landing. Italo Balbo is on the left.

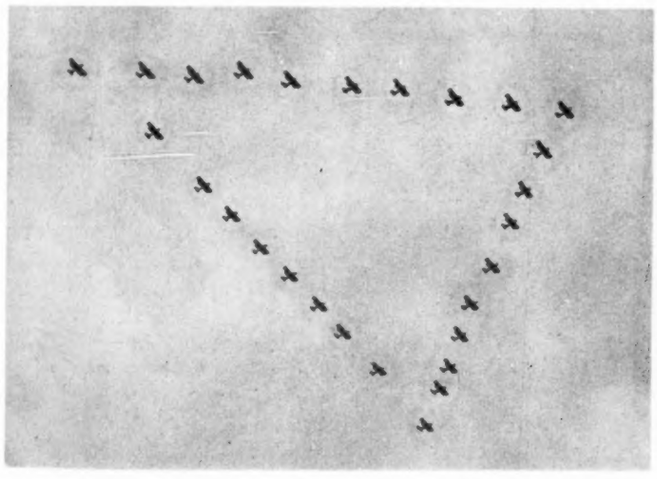
1919 to 1923 the authorities neglected aviation, leaving it entirely to private initiative. Nevertheless, a Rome—Tokyo flight, the first Italian liaison in history between Europe and the Far East, was carried out with a SVA aircraft by Arturo Ferrarin in 105 days ; in addition, a series of exhibition flights in Latin America by aces such as Antonio Locatelli, Giannino Ancilotto and Elia Liut were made. Liut crossed the Cordilleres range several times.

Furthermore, a first experiment with autonomous civil aviation was made on March 20th, 1920, by the constitution within the Ministry for Industry of an Under-Secretariat for the Mercantile Marine and Aviation. But all this was not sufficient to satisfy the Air Force's demobilized pilots, and the lack of orders gave the aircraft industry considerable concern. Political events forced the younger generation to rally to the Fascist movement which had established so-called "aviation groups" for the purpose of reestablishing the country's air power. The advent of Mussolini on March 20th, 1922, was followed on January 24th, 1923, by the constitution of a Commissariat for Aviation directly controlled by the Duce. Aldo Finzi, one of the seven pilots who had taken part in the Vienna flight of 1918, was the Deputy Commissioner. On March 23rd, 1923, the merger of military and naval aviation with their supply services and establishments was approved. An autonomous Air Force, similar to the only existing independent air force at the time, the British Royal Air Force, co-equal in status to the Army and the Navy, was thus formed. This organizational evolution was completed in 1925 by the promotion of the Commissariat to the level of an Under-Secretariat on May 4th and to that of a full Air Ministry on August 30th.

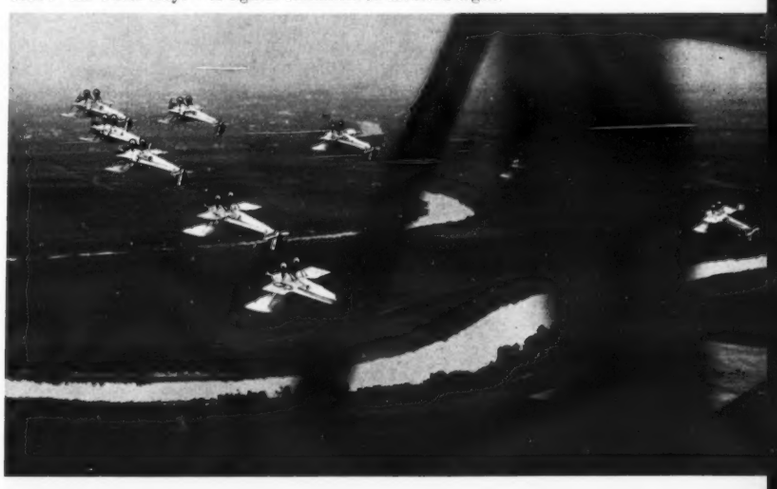
*

General Giulio Douhet's book, "Dominio dell'Aria," which was published in Italy in 1921, emphasized the fact that victory depends

1929 : Fighter aircraft flying in triangular formation under the command of Colonel Rino Corso Fougier who during World War II became Chief of Air Staff.



1929 : "Air Force Day." A fighter formation in inverted flight.



1930 : A Soviet Air Force delegation lands at Ciampino airfield, Rome, to return Balbo's visit to Odessa.

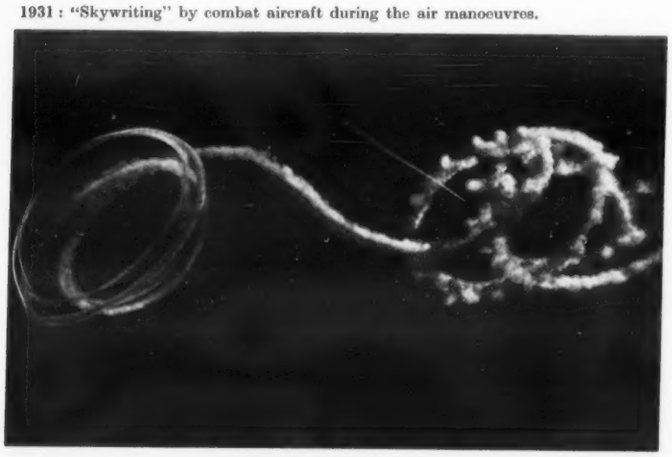
1931 : Air Force manoeuvres. Nine hundred military aircraft are lined up at Ferrara Airport.

upon supremacy in the air, that the strategic use of the air arm is more important than any other kind of warfare and that "it is necessary to resist on the surface in order to accumulate strength in the air."

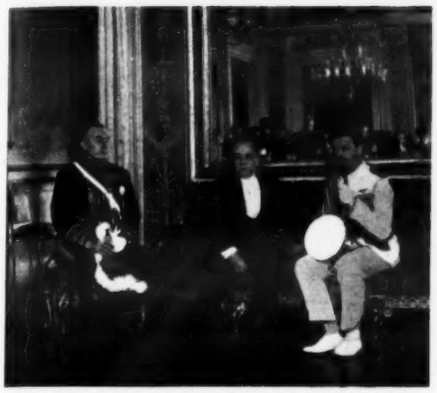
The philosophy pronounced by the Italian strategist in 1910 and completed by a work published posthumously under the title, "La Guerra di 19...," had a marked effect on Italian air policy before World War II. The new organization started by the reconstruction of the old personnel strength, by the manufacture of modern equipment, the setting-up of new units and the increase in scientific research. This zeal was encouraged and was of great value to Italian industry. Amongst innumerable individual exploits accomplished from 1925 to 1928 should be mentioned two long-distance flights by General Francesco de Pinedo : one of about 35,000 miles from Sesto Calende to Melbourne, Tokyo and Rome with a single-engined "Savoia 16ter" flying-boat ; and a non-stop crossing of the Atlantic from Cape Verde to Fernando di Noronha in 18 hours with a "Savoia 55" and after a tour of North and South America, back to Rome. Colonel Mario de Bernardi's victory in the Schneider Cup and the conquest of a speed record which for the first time in history exceeded (by 12 km) 500 km (310 m.p.h.) with a "Macchi 52bis" ; the distance records of records of Carlo del Prete and of Arturo Ferraro who remained in the air in closed circuit for 58 hours 37 minutes aboard a "Savoia Marchetti 62" over a distance of 7656 km (4,757 miles) and who flew from Montecelio, Rome, to Tauros, Brazil, in 49 hours, beating the straight-line distance record with 7188 km (4,466 miles). The first of these records was beaten by Colonel Umberto Maddalena and Captain Fausto Cecconi who in the same aircraft travelled 8188 km (5,088 miles) in 67 hours 13 minutes ; the speed and altitude records were gained by Lieutenant Francesco Agello in the "Macchi-Castoldi 72" seaplane and Major-General Mario Pezzi in the Caproni 161 landplane with 709 km (441 m.p.h.) and 17,083 meters (56,046 ft.), respectively ; the Arctic flights by the N.1 and N.2 airships of Umberto Nobile ; victories and records in all categories at great international air contests : Schneider Cup, Bleriot Cup, European Air Tour, Istres—Damas—Paris race and various aerobatics competitions.

Italo Balbo was appointed Secretary of State for Air on November 6th, 1926, seven months after the opening of the first airline from Turin to Trieste, across the plain of the Po and the Adriatic. Balbo realized the necessity of strengthening the *Esprit de Corps* of the growing Italian Air Force and of placing it on a basis of absolute equality with the two other Services. The memories of the air feats during the Italian—Turkish war and the first World War had paled. They had become part of the records of the Army and the Navy, since the Air Force did not then exist as an independent Service. Individual exploits no longer carried much weight because they were not carried out by the Air Force as a whole. In order to boost the morale of his Service and to popularize the Air Force throughout the nation, Balbo organized his famous mass flights. In 1928 he took sixty-one flying-boats on a circuit of the Western Mediterranean,

1931 : "Skywriting" by combat aircraft during the air manoeuvres.



1931 : Bologna is covered by a smoke screen during the Air Force exercises.



1931 : Italo Balbo's Rome—Rio de Janeiro mass formation flight with twelve S.M.55 flying-boats. Picture shows Balbo being received by the President of Brazil, General Getulio Vargas (centre).

1931 : The special air mail stamp issued on the occasion of Balbo's Rome—Rio flight.

stopping in Spain and in France. The following year thirty-five flying-boats visited the Eastern Mediterranean areas and the Black Sea. In 1931 Balbo, who by then had been promoted to full General, led a flight of twelve Savoia Marchetti SM.55 flying-boats from Orbetello to Rio de Janeiro. Two years later twenty-four aircraft of the same type carried out a cruise from Orbetello to Chicago and back to Rome. Upon his return, Balbo was made Air Marshal and promoted out of the Service, because Mussolini had begun to resent his popularity.

These mass formation flights were clever propaganda feats and laid the foundations of the tradition required by the Service. Although spectacular, they were based on first-class military proficiency and careful selection of human and technical material. The Orbetello school produced technicians who later gave proof of their outstanding capacity in the upper ranks of the Air Force, and the technical experience gathered on these cruises both as regards navigation, equipment and organization at intermediary points subsequently contributed to the development of overwater flying. Balbo placed this experience at the disposal of other countries by convening a congress of ocean fliers in Rome in 1932 : among others there attended Mermoz, Gronau, Coutinho, Alcock, Costes and Lindbergh. The public took a lively interest in the proceedings, and some of the resolutions then adopted now are part of the present ICAO's recommended practices.

Measures popularizing aviation included the annual air day, the *Giornata dell'Ala* which purported to represent the maximum in Air Force training and with its demonstrations of aerobatics and stunt flying attracted masses of spectators. Air manœuvres held in 1931 by two "opposing" formations of 1000 aeroplanes supplied data of great strategic and tactical value.

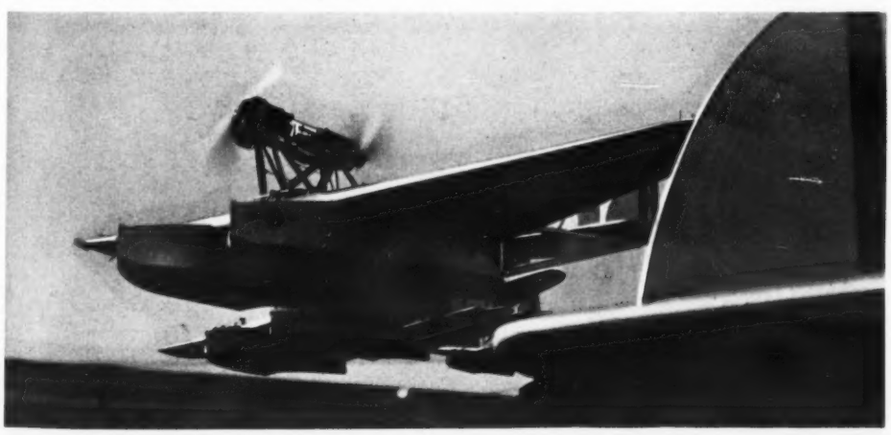
The telegram sent by the American newspaper magnate William Randolph Hearst on the occasion of Italo Balbo's formation flight to Chicago.

1933 : The crews of the 24 Italian S.M.55 flying-boats which, under the command of Italo Balbo, carried out a mass formation flight from Orbetello to New York, Chicago and back to Rome, are welcomed in New York. They are riding up Broadway, showered with the traditional ticker tape.

*

In the two years following Balbo's retirement the Italian Air Force continued its policy of breaking records by the dozen, while at the same time improving its military preparedness. On April 27th, 1935, the Aeronautical

Itali Balbo's S.M.55 twin-hull flying-boats arrive at the Lido, Rome, upon their return from their epochal flight to the United States.



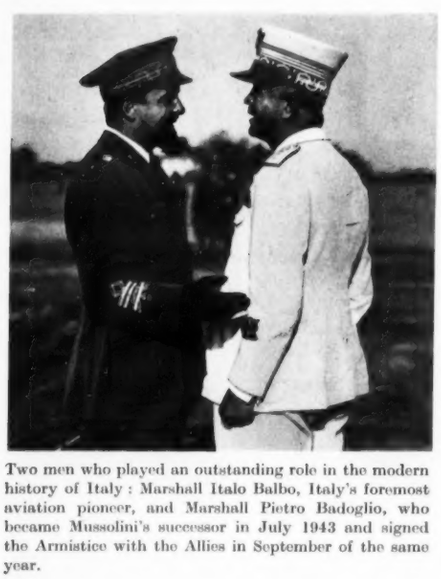
1937 : Pilot Francis Lombardi, who later became a well-known aircraft constructor, poses in a Japanese outfit (left) in Tokyo after completing a record flight to the Japanese capital. The gentleman with the outsize whiskers is General Nagaka, Vive-President of the Japanese Aero Club.

1938 : Mario Pezzi establishes a world altitude record of 56,043 feet (17,082 metres) in a Caproni biplane.

Mario Pezzi is greeted enthusiastically upon landing at Guidonia, after establishing a new height record.

Research and Test Centre of Montecelio was opened ; it was called Guidonia in memory of Lieut.-General Alessandro Guidoni who had met his death there seven years previously while carrying out parachute tests. This centre was one of the best-equipped in Europe.

The Ethiopian war broke out on October 3rd, 1935. More than 500 aircraft accumulated



Two men who played an outstanding role in the modern history of Italy : Marshall Italo Balbo, Italy's foremost aviation pioneer, and Marshall Pietro Badoglio, who became Mussolini's successor in July 1943 and signed the Armistice with the Allies in September of the same year.

over 41,000 flying hours and carried over a million kilograms of materials, ammunition and supplies.

There followed the Spanish civil war, during which the Italian Air Force fought on Franco's side for three years. In April, 1939, a formation of 304 aircraft joined in the occupation of Albania.

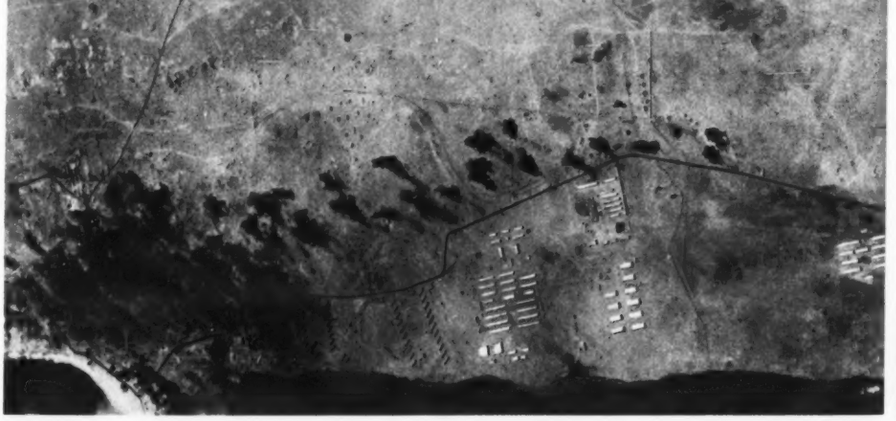
When Italy entered into World War II the Italian Air Force undertook its heaviest task. The first operations were launched from Piemont, Liguria and Lombardia against Southern France and Corsica, from Sicily against Malta ; from Libya and the Dodecanese against Egypt ; from Apulia and Albania against Greece ; from Libya and Italian East Africa against British positions along the Suez Canal and the Red Sea ; an air striking force fought in Soviet territory and from Belgium against Great Britain. The Italian Air Force concentrated chiefly on the war against enemy shipping, notably the British convoys sailing between Gibraltar and Alexandria. More than half the victories of the coastal air forces were scored by torpedo bombers from bases in Sardinia, Sicily, Libya and the Dodecanese against British convoys and their naval escorts. Spectacular long-range propaganda flights were directed against the petroleum refineries at Bahrein in the Persian Gulf.

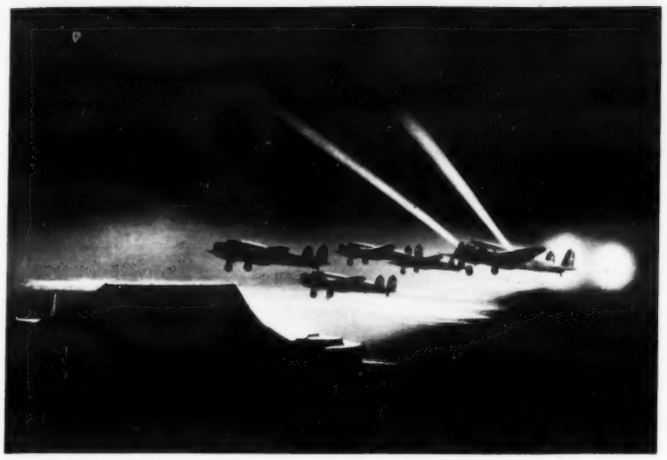
Forced on to the defensive, the Air Force continued to fight in Libya, Tunisia and Algeria, to defend Albania and East Africa and endeavoured to maintain its Mediterranean bases. At the time of the capitulation, the Service's equipment was completely worn out, and the crews were awaiting new machines. It had not been possible to introduce the new fighters developed by Fiat, Macchi and Reggiane, nor the Piaggio heavy bombers (commandeered by the Germans for transport duties during the evacuation of the Crimea) on a general scale. Despite the capitulation of September 8th, 1943, the Italian Air Force continued to be at war. The Allies used it particularly to give air support to the partisans in Northern Italy and in the Balkans.

*

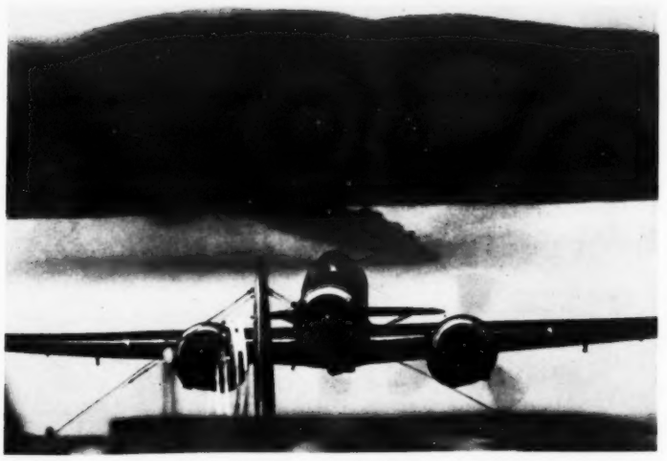
On June 28th, 1940, anti-aircraft batteries of the cruiser "San Georgio" anchored at Tobruk had shot down an Italian aircraft by mistake. This was an ominous event, for the

1940 : Italy enters into the war. Picture shows the first Italian air bombardment of the British supply dumps at Mersah Matruh, on the Egyptian border.





1940 : The Italian Air Force in action. Fiat B.R.20 medium bombers taking off on a night mission.



1941 : The three-engined Savia Marchetti S.M.79 was the standard medium and torpedo-carrying bomber of the Italian Air Force. It was intensively used against British fleet units in the Mediterranean area.

aircraft carried Air Marshal Italo Balbo. On the eve of the declaration of war, Balbo had urgently warned Mussolini against entering the war on the side of the Axis. He had pointed out that Libya could be held only with difficulty and only after the elimination of Malta as an air base. This concept was advocated later by Field-Marshal Kesselring. It was opposed by Field-Marshal Rommel, whose Africa Corps bogged down in the desert sand, short not only of water but also of the fuel which the British bombers based on the St. George's Cross Island regularly intercepted on its way across the Mediterranean. Unlike many others who shared his views but did not dare to speak up, Balbo made no secret of his aversion to Italy's declaration of war. He was convinced that the conflict could never be a so-called "lightning war" ; he particularly criticized the exclusively tactical concept of the Axis air forces, since he foresaw that the Anglo-Saxon conduct of the war would be "total." His frequent contacts with men such as Goering and Milch, as well as Sir Philip Sassoon prior to the irreparable division of the world into two hostile camps, caused him to take a some what pessimistic view of the events in which he was obliged, as a soldier, to take a prominent part.

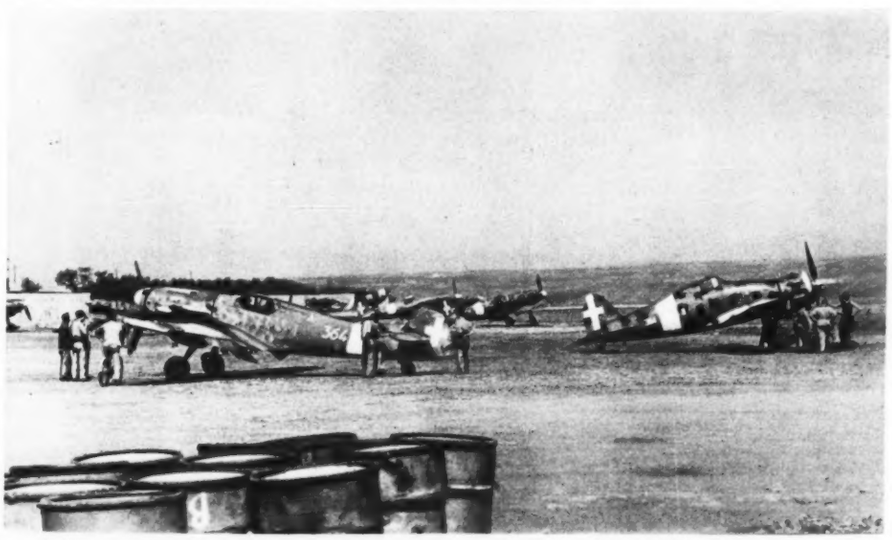
Another great airman, General the Duke Amedeo di Savoia-Aosta, Viceroy of Ethiopia and Commander-in-Chief of the Ethiopian front, was completely crushed by the war and eventually died in a prison camp. Other prominent pioneers of Italian aviation history were killed at the front or during the civil war. These included recordmen Stefano Cagna, Furio Niclo, Arthuro Ferrarini. Air Force Generals Sabato, Martelli Castalli and Roberto Iordi were executed as hostages by the German SS.

Those who remained went back to work undaunted, guided by the same instinct as Leonardo da Vinci and in the knowledge that even five years of war could not wipe out moral values which are founded on tradition. And now, five years after the war, they have decided to apply the experience of others to make up for lost time. This explains why Italian aeronautics, which with the *Camproni Campini* experimental aircraft of 1941 had taken the lead in the field of jet-propulsion, has sought the assistance of engineers abroad to catch up with modern jet developments ; but already it is again conducting its own experiments—the Fiat Gabrielli 80 jet trainer is an eloquent witness to this fact.

And the leaders of the small post-war Italian Air Force are working on the same principle as the aircraft industry : they are contracting and consolidating their Service to enable it to make a fresh start.

1943 : Piaggio P.108 four-engined heavy bomber of the Italian Air Force. This type of aircraft was commandeered by the Germans largely to evacuate German troops trapped in the Crimea.

1942 : Italian Air Force fighters in Sicily : left foreground, a Messerschmidt Me109 ; centre background, two Macchi M.C.205 single-seaters ; right foreground, a Macchi M.C.200 fighter.



From the Ashes of Defeat

The men of the German Luftwaffe's First Paratroop Division, advancing from the Tyrrhenian Coast and from the Alban Hills under the Command of General Student in the night of September 8th, 1943, with the objective of encircling Rome, were the first to discover the portentous fact that the remnants of the Italian Air Force had gone over to the Allies. From the numerous aerodromes dotting the countryside around the Italian capital, the few remaining servicable aircraft had taken off in the hours following Marshall Badolio's message of capitulation, to fly to the regions which the Germans had evacuated in the South. There they formed the original nucleus of the "co-belligerent" Italian Air Force fighting on the side of the United Nations.

By September 8th, 1943, the day on which the Armistice between the Allies and Italy came into force, the Regia Aeronautica had reached the end of its tether after 37 months of war. It had entered the hostilities with a first-line strength of 1,458 bombers and transports, 1,160 fighters and attack aircraft, 497 utility and army cooperation aircraft, and 307 naval aircraft. In addition, about 340 aircraft were assigned to the formations in East Africa, 2400 to flying schools and other non-operational units. The personnel strength consisted of 84,000 men, 6,300 pilots and 36,140 engineering and technical staff. According to semi-official statistics, 6,600 new aircraft were built by Italian industry in the first three years of the war. Of this total of 10,350 first-line aircraft, 6,733 were lost in action or by enemy action, 2,129 were discarded because of obsolescence. Of the remaining 1,488 only a few dozen were really servicable. Most of them were placed at the disposal of the Government which after the loss of Rome first settled in Apulia and later in Salerno.

Following the proclamation of Mussolini's "Italian Socialist Republic" in the North Italian regions still held by the Nazis, a second Italian Air Force came into being in that part of the country. It comprised pilots who previously had fought for the Duce and had now re-equipped themselves with aircraft left behind on Northern Italian airfields and in the North Italian factories. Added to this were a number of aircraft handed over by the German Luftwaffe. Altogether the Fascists had about 100 operational aeroplanes which were used for fighter missions and isolated torpedo attacks.

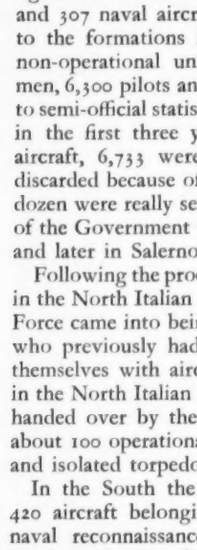
In the South the Government of Victor Emanuel III had about 420 aircraft belonging to 17 different fighter-bomber, dive-bomber, naval reconnaissance, observation and transport squadrons. The number of crews by far exceeded the number of available aircraft. When the Royal Air Force began to issue "Spitfires" to the "co-belligerent" air force, the latter was able immediately to go into action in the Mediterranean and Balkan theatres of war. The 11,196 combat sorties and 9,022 transport missions justified the declaration of Britian's War Premier, Winston Churchill, on July 24th, 1944 : "The loyal Italian Air Force have fought so well that it shall be my special endeavour to supply them with modern British equipment."

After the cessation of hostilities the Armistice conditions remained in force in Italy. The country's aeronautical activity diminished considerably but never was suspended. The "military courier service," a kind of Italian Air Transport Command, originally was the first scheduled system of transportation available to officials and private individuals between the peninsula's devastated population centres.

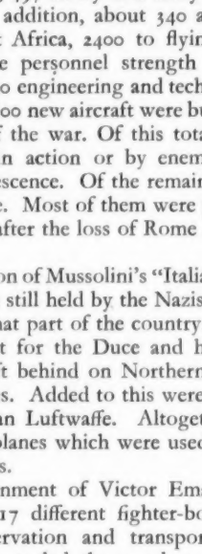
The Peace Treaty, of which the instruments of ratification were handed over at the Quai d'Orsay on September 15th, 1947, limited the establishment of the Italian Air Force to 25,000 men and 350 aircraft. Of the latter, 200 can be armed for defensive fighter missions, the balance is to serve for training and a variety of special purposes. The use of bombers, guided missiles and several most modern types of weapons is prohibited, but no boundaries have been set for the expansion of civil aviation and the manufacture of equipment, although there is a ban on exports to Germany and Japan.

This was the basis on which Italy began her great task of rehabilitation. In the five fiscal years from July, 1945, to June, 1950, a total of approximately 122,700,000,000 lire was spent on aeronautics. The 1950-51 estimates provide for an expenditure of 55,000,000,000 lire, but the extraordinary heavy burden resulting from the destruction of the country's war-time strength, the retention and reconstruction of the remaining branches of the Service and the difficulties encountered in the reorganization have not permitted to build up the country's air strength even to the limit established by the Peace Treaty.

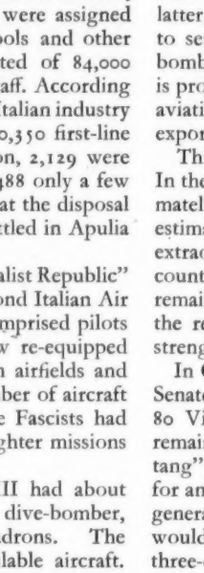
In October, 1948, Defence Minister Randolfo Pacciardi informed the Senate that the Italian Air Force then had the following aircraft strength : 80 Vicker-Supermarine "Spitfire" single-seater fighters which would remain servicable for another year ; 48 North American P-51 "Mustang" single-seater fighters which were expected to remain in operation for another two years ; 69 obsolete SIAI-Marchetti SM. 79 three-engine general purpose aircraft ; 31 SIAI-Marchetti SM. 82 transports which would be capable of operating until the end of 1949 : 19 Fiat G. 12 three-engine transports, 36 CANT. Z.506 three-engine seaplanes, both



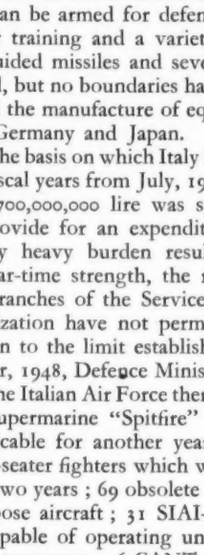
Defence Minister Randolfo Pacciardi.



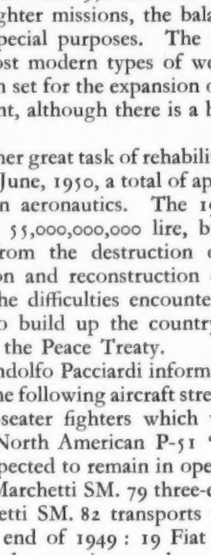
Senator Enrico Malintoppi, Under-Secretary of State at the Defence Department.



General Mario Ajmone Cat, Chief of Air Staff.



General Aldo Urbani, Air Secretary General.



General Alberto Briganti, Chairman of the Air Force Division of the Supreme Defence Committee.

General Fernando Silvestri, Chief of Air Defence.

General Pietro Pinna, Director General of Civil Aviation.

General Ferdinando Raffaelli, Deputy Chief of Air Staff.

General Enrico Bonessa, Director General of Aircraft Production.

Professor Gaetano Arturo Grocco, member of the Papal Academy.

of which types were then approaching the age limit ; and 80 trainers of various models.

Newly placed into operation in the meantime have been about 100 Beechcraft and several Stinson liaison aeroplanes from American war surplus stocks, half a dozen Fiat G.12 transports withdrawn from the commercial air services, 50 Lockheed P-38 "Lightning" twin-engine single-seater fighters ; as well as a few single-engine Fiat G.46, Macchi MB.308 and Ambrosini S.7 aircraft which are used partly for training and partly for experimental purposes. Finally, the Air Force has received the first five de Havilland "Vampire" jet fighters which are intended for the training of Italian fighter pilots.

During the war the Italian Air Force had lost a quarter of its air crews, a large number of ground personnel and numerous engineers and technicians. An unofficial source stated in 1946 that more than 6,000 Air Force members were reported killed or missing, whereas 3,000 had to be invalided out of the Service due to wounds received in the war. For four years no recruiting of any kind was undertaken, so that the Air Force establishment, weakened by the war and further reduced under the Peace Treaty clauses, was starved of new personnel. At the time of the conclusion of peace, the Air Force still had 40,000 men. Some of these were reserve personnel, but about 12,000 officers and non-commissioned officers had to cut short their careers and were paid off. The compensation paid to them still burdens the Italian air estimates with a large, unproductive sum.

A Bill submitted to Parliament last May outlines the provisional establishment of the Italian Air Force and provides for a regular strength of 1,616 professional officer pilots, 450 quartermaster, supply and general service officers, 200 specialized personnel, 585 engineering personnel, 510 administrative officers and 244 air surgeons.

Funds available under the budget do not permit an increase in the strength to the ceiling authorized by the Peace Treaty. The situation of today can be summed up as follows : flying equipment has reached the end of its usefulness, it is out-performed by more modern types and unsuitable for modern training ; excepted from this statement is an entirely insufficient number of jet fighters. Aerodromes and navigation aids, the latter of which are largely used by the commercial air services, are still inadequate, although a major postwar effort has been concentrated on their restoration and expansion. Flying and engineering personnel have had no opportunity in the latter stages of and immediately after the war to undergo modern training and keep abreast of technical progress. The low pay scales, which only now have begun to improve, had an unfavourable effect on the number and quality of entrants and have rendered difficult the "rejuvenation" of the regular Air Force units.

Today the Italian Air Force is placed under the Ministry of Defence headed by Defence Minister Randolfo Pacciardi. The Minister is assisted by three Under-Secretaries of State, whose responsibilities cover all three Services. The specialized problems of civil aviation are the responsibility of Senator Enrico Malintoppi.

The Central Air Force administration is under the Secretary-General for Air, Air Force Lieutenant-General Aldo Urbani ; it comprises eight Directorates-General and two Inspectorates (cf. chart).

Commander-in-Chief of the Italian Armed Forces is the President of the Republic. The Chief of Staff of the armed forces, General Claudio Trezzani, collaborates with the Defence Minister to ensure the preparedness of all forces.

The Air Staff is headed by Air Force Lieutenant-General Mario Ajmone Cat, who has a deputy in the person of General Ferdinando Raffaelli. The Air Staff has three Divisions, namely : (1) Operations and Training, (2) Organization and Mobilization, (3) Engineering and Supply ; it also comprises three offices for Intelligence, Intelligence Interpretation and Anti-aircraft Defence. In addition, there is an Inspectorate of Training which is responsible for the coordination of training programmes and supervises the Air Force's training activities. The Defence Minister is assisted by an advisory body, the Supreme Defence Committee ; the Chairman of the Air Force Sub-committee of this body is General Alberto Briganti.

The territory of Italy is divided into four Air Zones, with command headquarters in Milan, Padua, Rome and Bari ; added to these are the regional Air Force Commands for Sardinia and Sicily with headquarters at Cagliari and Palermo, respectively, and finally an air command of the mandate troops in Somaliland. Each air zone or Air Force command is responsible for the technical ground organization and the supply services in the area under its jurisdiction, as well as for the assignment of the air units in its territory.

The former Air Ministry in Rome, today the seat of the Air Department of the Ministry of Defence.

These units are normally divided into wings, each of which has two groups of two or three squadrons. The wings have their own materiel organization which gives them a certain independence and mobility will defined limits. There also exist a number of separate groups and squadrons. These are chiefly the air-sea rescue units and the personnel training squadrons attached to major staffs and staff officers.

The rehabilitation programme of the Italian Air Force is based on the principle that only a nucleus of personnel of the highest military and operational proficiency can make up for the numerical weakness of the air strength authorized under the Peace Treaty and can make an efficient contribution to the mutual defence as required under the Atlantic Pact. For this reason particularly severe standards are being applied to the selection and training of personnel.

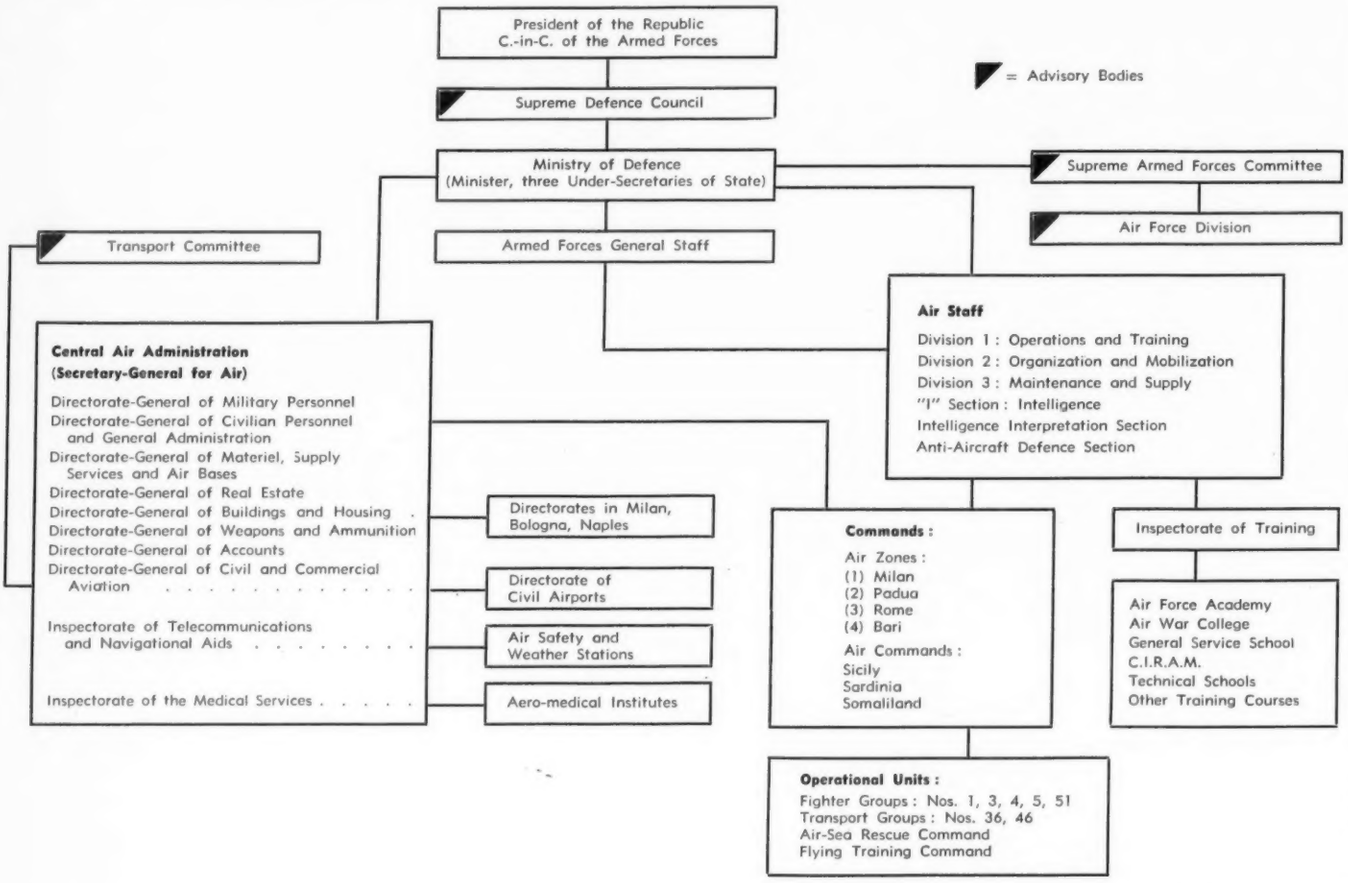
Candidates for entry as active Air Force officers must be holders of the matriculation certificate and be between 18 and 22 years of age ; they are selected by means of competitive examinations. Upon acceptance they must accomplish a three-year curriculum at the Air Force Academy, which has the character of a University. They graduate from the Academy with a Lieutenant's commission and move to the Air War College for advanced training. They leave this College with the rank of First-Lieutenant and are then assigned to an operational unit. Plans now under study would enable regular Air Force pilots to be selected also from amongst Air Force N. C. O.'s ; they would have to absolve a two-year introductory course prior to being commissioned.

Specialized officers are chosen from N. C. O.'s on the basis of seniority and examinations, whereas quartermaster, supply and general service officers are selected from reserve officers of the different Services and prepared for their tasks in a special Air Force services school.

Young men of less than 20 years of age aspiring to acquire flying licences are trained as Air Force Reserve officers.

General view of the Air Force training establishments in Florence.

Structure of Italian Aeronautical and Air Force organization



Regular officers of the Engineering Corps, the Administrative Branch and the Medical Branch are chosen among holders of corresponding University degrees and professional certificates and undergo special training courses prior to being commissioned.

N.C.O. pilots are trained from among young people of less than 20 years of age who have enjoyed a High School education. They are promoted to the rank of Sergeant after 12 months of training. N.C.O.'s of other branches of the Air Force are selected and trained along similar lines. An exception is made in the case of engineering N.C.O.'s. These enter the Air Force as apprentices at an age of less than 18 years and must have obtained an apprenticeship certificate at an approved engineering school. After nine months of training they become Technical N.C.O.'s on Probation and then undergo a practical training period with the maintenance and procurement services of an operational unit. Upon terminating this training period they are given the title of "specialist" ; if they decide to continue in the Service, they are appointed First-Class Specialist Airmen after 20 months and are promoted to Sergeant after an additional four-month period in an N.C.O. training course.

A variety of refresher and instruction curricula is provided for the continuous training of officers. Pilots with the rank of Captain are obliged to undergo the "normal curriculum" of the Air War College, whereas Lieutenant-Colonels must follow the "senior curriculum." The former still has the character of a training course, whereas the latter is devoted to the independent study of problems of war and air war doctrine. Promotions to higher ranks are dependent upon attendance of one of these courses. Subalterns may attend courses on radio and radar, mapping, navigation, armaments and photo-interpretation,

The Air War College in Florence.

The square of the general service training school in Florence.

or else follow courses at the Naval or the Army Academies. Higher-ranking officers may attend courses on communications and navigation as well as Defence Staff Courses, in addition to special curricula at the Army and the Naval Academies. A number of officers are seconded to foreign war colleges, such as the R.A.F. Staff College at Andover, the French Ecole de Guerre, the U.S. Air Force Air University, etc. Similar training possibilities are provided for non-flying officers, and special training schools are available for N.C.O.'s.

The flying training schools proper at present are concentrated at the Air Force stations in Apulia. Training is carried out in several stages under a programme aiming at maximum operational proficiency.

The Air Force Academy has its seat at Nisida, near Naples. The Air War College, the Air Force Service School and most of the technical training institutes are located in Florence. The young special service candidates and technical tradesmen are trained at Caserta. Other specialized training courses are held in Rome.

The complete destruction of the Guidonia Air Force base, which housed the Directorate of Research and Development, was a heavy blow to Italian aeronautical research. In its endeavour to restore the Institute, the Air Force first had to content itself with the few installations which emerged from the war unscathed. Plans for a new research centre are now being established. Although it will be much more modest than Guidonia used to be, it will contain all the essential testing and research equipment. In this connection the Defence Minister last year stated in Parliament that from an aeronautical engineering point of view Italy was at least ten years behind the most progressive nations.

For highly specialized investigations, the Italian Air Force largely depends upon the Institutes of Technology in Turin, Rome, Milan and Pisa, as well as several other research institutes. The military flight test centre is undergoing a thorough reorganization at present and subsequently will be charged with all kinds of practical testing programmes.

Italy's aircraft industry is in a precarious position. In 1938, a total of 80,000 metal workers and electric instrument specialists earned their daily bread in the aircraft industry. By 1943 this number had increased to 200,000 . . . today there are fewer than 5,000. These figures show the extent to which this branch of industry has shrunk as a result of the change-over to non-aviation manufacturing activities and the closing of aircraft plants. The size of the industry will probably diminish even further under a current programme providing for the reorganization of non-viable industries. The military aviation authorities are endeavouring to keep the remaining aircraft plants occupied in order to ensure that the country's military and civil aircraft requirements are met from the country's own resources and to assure these factories a role in the manufacturing programme of the Atlantic Pact countries. Finally, it is hoped that they will export an increasing portion of their production to the nations in Southeast Europe and the Middle East.

The former palace of the Bourbon kings at Caserta today is the head-quarters of the Air Force Engineering Training School.

The extent of which the Italian aircraft industry is capable of keeping itself alive is illustrated by export statistics for the past two years : 1948 : 75 aircraft weighing 286,600 kg and valued 2,837,034,000 lire. 1949 : 62 aircraft weighing 198,400 kg and valued 2,658,858,000 lire.

These figures by far exceed the total value of the contracts placed by the Italian Government in the same period. This touches upon one of the main causes of the industry's critical situation : inadequate financial backing by the State and hesitant attitude of the Government towards aeronautical problems. It is often overlooked that in comparison with other Italian industries and in relation to its turn-over, the aircraft industry can employ a large labour force. Furthermore, owing to the even distribution of aeronautical manufacturing plants over the entire area of Italy, this industry offers important advantages in the field of defence and social security.

Ciampino Airport, Rome.

The beginning of production of airframes and power plants to the designs of The de Havilland Aircraft Co. no doubt may be regarded as an indication of the industry's revival. However, production will be able to assume certain proportions only if the State places sufficient funds at the disposal of the industry in place of the pittance granted

The colors of the air force groups disbanded after the war.

Air Force police exercises.

The first de Havilland "Vampire" lands at Amendola airfield.

An Italian fighter unit of today : three "Vampires" and a dozen "Mustangs" at Ciampino.

to it at the present time. Foreign manufacturing rights will presumably be acquired also for multi-engined transport aircraft of more than one type. They are designed to permit the industry to catch up with the ten-year engineering advance of other countries. At the same time, this would encourage the standardization of equipment to which the signatories of the North Atlantic Pact have unanimously agreed. During the time which the Italian aircraft industry requires to start up its own production, a modest number of foreign aircraft will be imported in order to allow the Air Force to train its pilots on modern types. For the time being and in the near future, the Italian aircraft manufacturers will furnish training and specialized aircraft types. Prototypes and small batches of such aircraft are available.

No distinct guiding lines for the future procurement programme of the Italian Air Force are at present discernible. However, it is obvious that the military authorities are interested largely in light and medium-heavy types. In these two aircraft categories, a whole range of prototypes are already available, and their trials are being watched with great attention. They include the twin-engined Macchi MB.320, Caproni Ca.193, SIAI-Marchetti SM.101, Piaggio P.136 and the single-engined Fiat G.46, Ambrosini S.7 and Preti 110. The construction of the Breda BZ.308 four-engined transport and other giant transport projects are not indicative of present development trends. The discussion of the advantages of two- or four-engined designs as compared with three-engined types is still going strong in Italy. The spreading of an aircraft's engine power over three engines is advocated by Air Staff engineers for aircraft whose size would not warrant the installation of four engines. An example frequently quoted is the Fiat G.212. The manufacture of small aircraft, such as the Macchi MB.308 is being closely followed with a view to determining the aircraft's suitability as a trainer. Attention is also being paid to the helicopter, and a number of novel designs are approaching completion.

Aircraft of the Italian Air Force fly over the Via Imperia and the Coliseum on June 2nd, 1950, fourth anniversary of the Republic.

While the development of jet-propelled aircraft is now making headway, progress has been slow owing to conditions prevailing immediately at the end of the war.

In the field of aeronautical science, several Italians have gained world renown. *Gaetano Arturo Crocco,* ordinarius for aeronautical engineering at Rome University, member of the Papal Academy, Inspector-General of the Air Force Engineering Corps, associate member of numerous foreign academies and research institutes, found it possible to publish several notable works directly after the war : *Application of atomic energy to planetary navigation, supersonic flight, jet propulsion at great heights,* elements of straight jet and propeller turbine propulsion are some of the problems with which he has dealt. Well-known in wide circles are also *Professor Modesto Panetti,* of Turin Institute of Technology, and the renowned aerodynamicist *Carlo Ferrari.* Engaged in active research work in the United States are several Italian scientists, such as *Professor Luigi Crocco, Engineer Campini* (creator of the first jet-propelled aircraft) and *Professor Ferri.* About fifteen Italian research scientists, professors and engineers emigrated to Argentina as a result of the immediate post-war difficulties. They are rendering excellent service to their adopted country.

"From the Ashes of Defeat" (Dalle Ceneri della Disfatta) is the title of a widely discussed book by Admiral Maugeri, former Chief of Naval Staff. This book, which has been published by an American firm, discloses the fact that agreement had been reached by Italian and British naval men long before the capitulation and the subsequent period of "co-belligerency." The title of this story does not refer to such dealings. Throughout the course of the war Italy's Air Force stuck to its guns. But "from the ashes of defeat" a new Italian Air Force is now arising. It is pursuing an aim which will remain within reach of its practical possibilities. It will succeed if it can save its spirit even though it will have to adapt its material facilities to the modest resources at its disposal today and if it can continue to count upon the devotion of men who only today are allowed to speak their minds again.

In order to meet its future commitments, Italy's Air Force requires three things :

— A programme spreading over several years for the renewal and standardization of its flying equipment within the maximum limits laid down under the Peace Treaty. This will require an expenditure of about 100,000,000,000 lire.

— The restoration of air bases, ground facilities and ground equipment in accordance with the effective air strength of the Air Force and eventual Allied air base requirements in the Mediterranean area.

— Expansion of facilities required for the training of a hard core of the Air Force which, although it would remain within the limits of the Peace Treaty, might form the skeleton of a future, enlarged air arm.

At the beginning of this article it was claimed that the paratroopers of General Student's division had witnessed events which were decisive for the future of the Italian Air Force. The aircraft which took off from Centocelle and other fields for the South before the Germans' eyes made it possible for the Peace Treaty to allow Italy to retain an Air Force and to restore Italy's commercial airline system and aircraft industry to full freedom.

Italy can claim today to have risen from the ashes of defeat.

Italy Between Bermuda Partners

The resurrection of Italy's civil aviation after World War II too place under the most contradictory conditions. Controversy was not limited to academic discussions, of which there certainly was no lack, but manifested itself in open clashes between civil and military authorities, and between foreign and Italian air transport interests. In particular, Italian aviation circles unceasingly advocated complete autonomy for Italian air transportation.

Juridically, organizationally and technically, Italian civil aviation (air transportation, private and sporting aviation) is controlled by the Directorate-General of Civil Aviation at the Ministry of Defence under General Pietro Pinna. Political problems are the responsibility of one of the three Under-Secretaries of State for Defence, Senator Enrico Malintoppi, one of the closest collaborators of Randolfo Pacciardi, the Minister.

Unlike Parliament and certain air transport circles, the Government has never been in favour of an administrative separation of civil and military aviation. The Government considers that such a step would result in a costly duplication of services and expansion of the Government's bureaucracy which ultimately would harm the homogenous development of Italian aviation as a whole. On the other hand, the Government recognizes the advantages which derive from separate budget estimates and budget appropriations and from a strengthening of the technical organization of central and regional civil aviation authorities.

Civil air transport operations and air navigation aids are controlled by authorities which largely employ military personnel but concentrate on purely civilian tasks. The Directorate-General of Real Estate controls the construction and operation of airports, the Directorate-General of Public Works deals with the erection of ground installations, whereas the Inspectorate of Telecommunications is responsible for the air safety services.

From June 10th, 1940, the date on which Italy entered into World War II, until April 14th, 1942, the date of inauguration of the first postwar air service, the entire Italian air transport system was monopoly of the Air Force. Until September, 1943, it was operated by the "Commando Servizi Aerei Speciali" and subsequently by the "Commando Corrieri Aerei Militari."

One of Linee Aeree Italiane's newly acquired Douglas DC-6 transports.

In June, 1944, the Italian Government, which on September 8th, 1943, had been shifted to Southern Italy, returned to Rome. Work on a civil aviation reorganization programme was immediately taken in hand. At the beginning this merely involved the establishment of an inventory and the elaboration of the most elementary plans. In 1945 and 1946, there followed tedious and not always very smooth negotiations with the Air Committee of the Allied Armistice Commission and with certain American and British economic interests.

The first to take an active interest in Italian air transportation were the Americans. On February 11th, 1946, representatives of Trans World Airline made an agreement with the Italian authorities for the foundation of a jointly-owned airline company which would operate an Italian route network on behalf of TWA.

In May of the same year, the US Government intimated to TWA that it did not approve of its agreement with the Rome Government. In a letter to TWA's President, Jack Frye, the then Under-Secretary of State Dean Acheson stated that the US Government reserved the right to invalidate any clauses which would provide an operating monopoly for the new company. The US Government continued to adhere to the principle of not establishing any economical privileges whatsoever in any ex-enemy country. At the same time, the US State Department told the British Foreign Office that it would not intervene with the Italian Government to recommend a British participation in the projected joint company.

On June 8th, 1946, a second convention was signed, this time between the Italian

An SM. 95 of Alitalia about to land at Rome Airport.

Danilo Sartogo, President of Italy's National Air Transport Federation.

Engineer Manillo Zerbinati, President of the Aero-Club of Italy.

Dr. Guido Ringler, President of ALI-Flotte Riunite.

Prince Marcantonio Pacelli, President of Linee Aeree Italiane.

Count Nicolo Carandini, President of Alitalia.

Captain Annibale Pecoroni of ALI-Flotte Riunite, who has logged nearly 3,000,000 kilometres in flight.

Captain Corrado Lotti of Linee Aeree Italiane had flown 2,811,271 kilometres in the air by the end of March, 1950.

Captain Armando Ulivi of Alitalia totalled 2,900,000 aircraft kilometres up to the end of last March.

Government and the British Overseas Airways Corporation. This agreement, which was roughly similar to the one previously concluded with TWA, provided for the foundation of an Italo-British jointly-owned airline.

What had happened between the time of the formation of the Italo-American company and the American note to Britain ? The background to these events has never been made public. Informed circles believe that during the negotiations for the American-British air transport agreement in Bermuda in the spring of 1945, fruitless attempts were made to coordinate the two countries' air transport interests in ex-enemy countries. No matter what happened, it is a fact that as soon as Washington had defined its attitude, renewed negotiations took place on a basis of unfettered competition. Ultimately, these led to the two agreements signed by the Italian Government with Trans-World Airline and British Overseas Airways Corporation. On September 16th, 1945, two airlines were founded, namely, the Italo-American *Linee Aeree Italiane* and the Italo-British *Aerolinee Italiane Internazionali.* TWA held a 40 percent interest in the former, BOAC (later BEAC) a similar share in the latter. The terms governing the selection of the Italian partners, the control authorities within the companies, and the distribution of profits ensured that foreign influence in the two companies was predominant at least in the initial period.

*

Today the Italian air transport system labours under the sign of a show-down between American and British interests on the one hand and Italy's national aspirations on the other. Following the prevention of the establishment of an LAI monopoly as a result of Acheson's declaration, ten companies were licensed to operate regular air services in May 1947 : LAI and Alitalia (short for Aerolinee Italiane Internazionali) ; three companies whose names recalled the "heroic epoch" of Italian civil aviation : Aviolinee Italiane, SISA, Transadriatica ; as well as five companies of a more regional character, of which the Sardinian Airone and the Tuscan Aereo Teseo gradually assumed considerable importance.

On April 15th, 1947, LAI started operations, followed by Alitalia on May 5th. On June 5th the Armistice Commission authorized the Italian Government to inaugurate international air routes.

Chaos continued to reign as regards the allocation of route concessions. LAI was theoretically entitled to operate the most lucrative domestic routes, but the simultaneous inauguration of services by the other companies resulted in a dispersal of the traffic volume and the overlapping of all flying schedules. Alitalia should have confined its operations to international routes, as it had taken over the Government-owned pre-war Linee Aeree Transcontinentali Italiane (LATI) or at least secured the latter's South American operating licence. LATI, which in theory had survived the war, made the most vigorous opposition and began to organize special flights to Central America. In a kind of "aeronautical slap-happiness" following upon the long hibernation of Italian civil air transportation, a total of 63 route certificates were distributed among the ten airline companies, not to mention those which LATI received as the eleventh airline, although in the face of vociferous protests.

These eleven companies decidedly were more than the Italian traffic could bear and resulted in the launching of the most grotesque ventures—apart from the operation of scheduled services—and the execution of the most unlikely air transport missions. Two years later, one of the eleven scheduled lines went into bankruptcy and three others decided to stop operating the air routes allocated to them. Another year later, four of the surviving airlines got together and formed *ALI-Flotte Riunite,* a company in which the Fiat concern held a major interest.

Since that time, LATI has been merged with Alitalia, and new negotiations are now aiming at a consolidation of the latter concern with ALI-Flotte Riunite. If this deal were closed, only two major airlines would remain in Italy : the companies which originally were founded on the basis of contracts concluded by the Italian Government with TWA and BOAC.

LAI, which has a standardized air fleet of 16 Douglas DC-3 war surplus transports and operates an equally standardized route network in the Mediterranean area, succeeded in obtaining satisfactory operating results. Its annual reports disclose net profits, and the company is planning to inaugurate a Rome—New York service with Douglas DC-6 aircraft. A Marshall Plan loan of $4,500,000 is about to be granted to the company to enable it to pay for the modern DC-6 transports.

Alitalia, which concentrates on trunk routes,

now operated to Central and South America, East Africa, Central Europe and North Africa. Certain difficulties resulting from the company's motley air fleet, which was acquired to satisfy the interests of certain shareholders, were overcome without foreign help. Today the company operates three Douglas DC-4s, five SIAI-Marchetti S.M. 95s (to which will be added three more owned by LATI) and four Avro-"Lancastrians." With the exception of the North American route, the company operates the most lucrative services of Italy's overseas air transport system.

ALI-Flotte Riunite, in the 17 months of its existence, has continued the traditions of the old Avio Linee Italiane founded by the Fiat concern in 1926. The earlier regional companies, Airone, SISA and Transadriatica, were taken over by ALI, the resulting ALI-Flotte Riunite took over their operations and now flies domestic and international services in Europe and the Mediterranean area. Certain organizational difficulties were inevitable because some of the company's routes overlapped schedules operated by other companies. ALI's fleet consists of 19 Fiat G. 212 and Douglas DC-3 transports.

*

None of the Italian airlines is subsidized by the Government, not even indirectly through tax facilities or allocations for the ground and air navigation services. The contracts concluded with the Post Office do not provide for any guaranteed minimum operational revenues, and compensation is paid only for transport service actually performed. This somewhat ungenerous treatment of the Italian commercial airlines is criticized not only by the Italian "National Air Transport Federation" but also in Parliamentary circles which time and again have insisted upon the adoption of a clearly defined air transport policy by the Government.

The Government's policy, on the other hand, must take into account the ten-year foreign commitments it has undertaken. Until 1955 the Government must maintain the privileges granted to TWA and BEAC, successor to BOAC. Under these conditions the Government cannot contemplate the creation of a national monopoly company such as exists in nearly every one of the other European countries.

The question has been asked whether the liquidation of Ala Italiana as the national airline and the Cinderella treatment accorded to the Government-owned LATI must be interpreted as political shortsightedness. Were these events attributable to the predominance of private interests ? The real background is difficult to discover since the reproaches made to the Government never contain any concrete indications or criticisms of specific cases, regulations or measures.

In the meantime, the step-by-step revision of the Italo-American and Italo-British contract clauses has produced a substantial increase in Italy's participation in these joint airlines. The foreign capital interest has dropped (in the case of Alitalia it has already decreased to a mere 29 percent). Furthermore, the position of the Italian air carriers has been reinforced through changes in their articles of Association.

Putting their numerous critics to shame, these contracts of 1946 became the foundation of the full and rapid revival of Italian civil aviation, inasmuch as it succeeded in turning the existing rivalry between Americans and Britons to its own advantage. In a certain measure the Anglo-American Air Agreement of Bermuda became the starting post for Italy's post-war transportation. Do the rival influences exercised by Washington and London on Italian civil aviation still counter balance each other ? The struggle for the Rome—New York operating licence has been decided in favour of the American TWA, but this victory has been equalized by the absorption of LATI in Alitalia and by the Italo-British company's initiative in opening services to Africa and Germany.

International network of Italian airlines

Aerolinee Italiane Internazionali

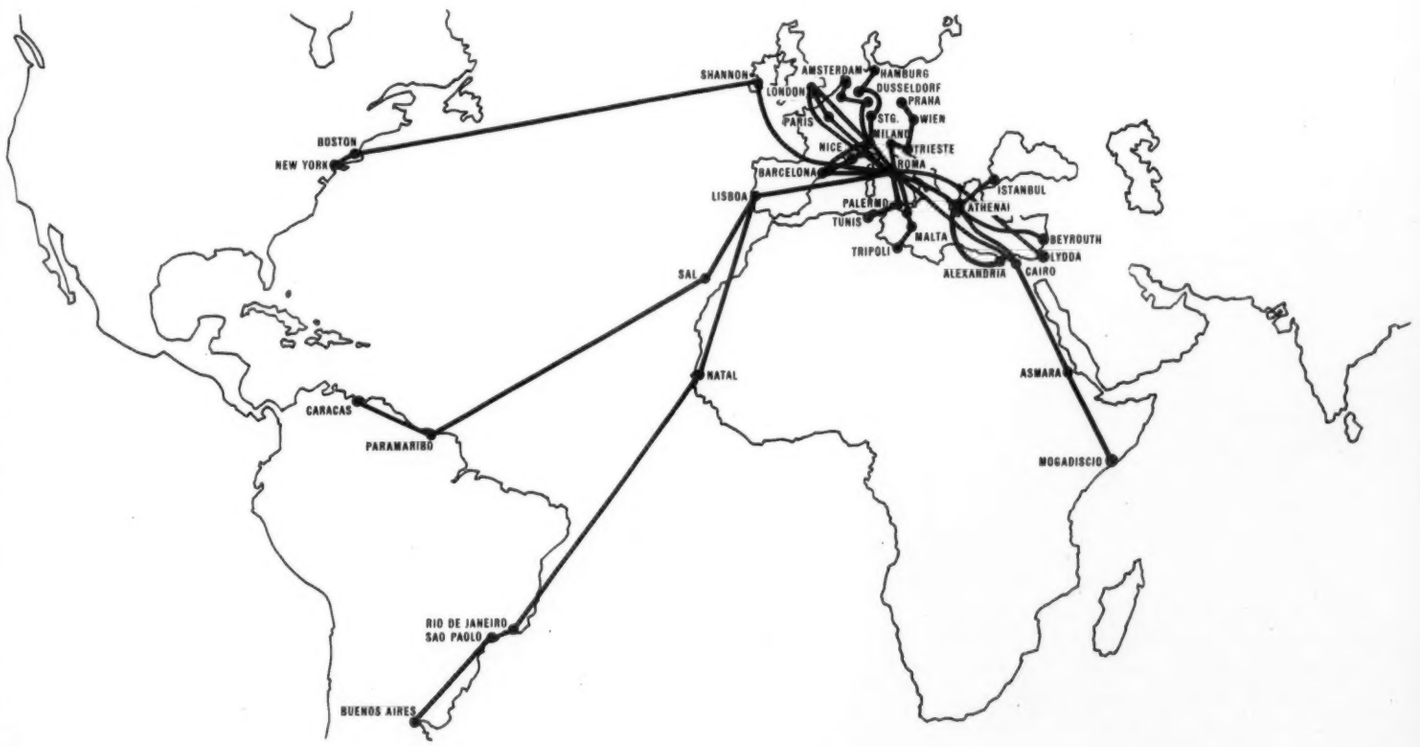
1. Rome - Lisbon - Dakar - Natal - Rio de Janeiro - Sao Paolo - Buenos Aires.
2. Rome - Lisbon - Sal Island - Paramaribo - Caracas.
3. Rome - Catania - Malta - Tripoli.
4. Rome - Cairo - Asmara - Mogadishu.
5. Rome - Milan - London.
6. Rome - Paris - London.
7. Rome - London.
8. Rome - Milan - Stuttgart - Dusseldorf - Hamburg.

Linee Aeree Italiane

9. Rome - Shannon - Boston - New York.
10. Rome - Athens - Cairo.
11. Rome - Lydda.
12. Rome - Athens - Lydda.
13. Rome - Athens - Istanbul.
14. Rome - Athens - Alexandria.
15. Rome - Palermo - Tunis.

ALI-Flotte Riunite

16. Milan - Paris.
17. Rome - Venice - Gorizia (Trieste) - Vienna - Prague.
18. Milan - Barcelona.
19. Milan - Nice - Barcelona.
20. Milan - Frankfurt - Brussels - Amsterdam.
21. Rome - Barcelona.
22. Rome - Athens - Beyrouth.



An Alitalia SM. 95 flies over Italy's capital.

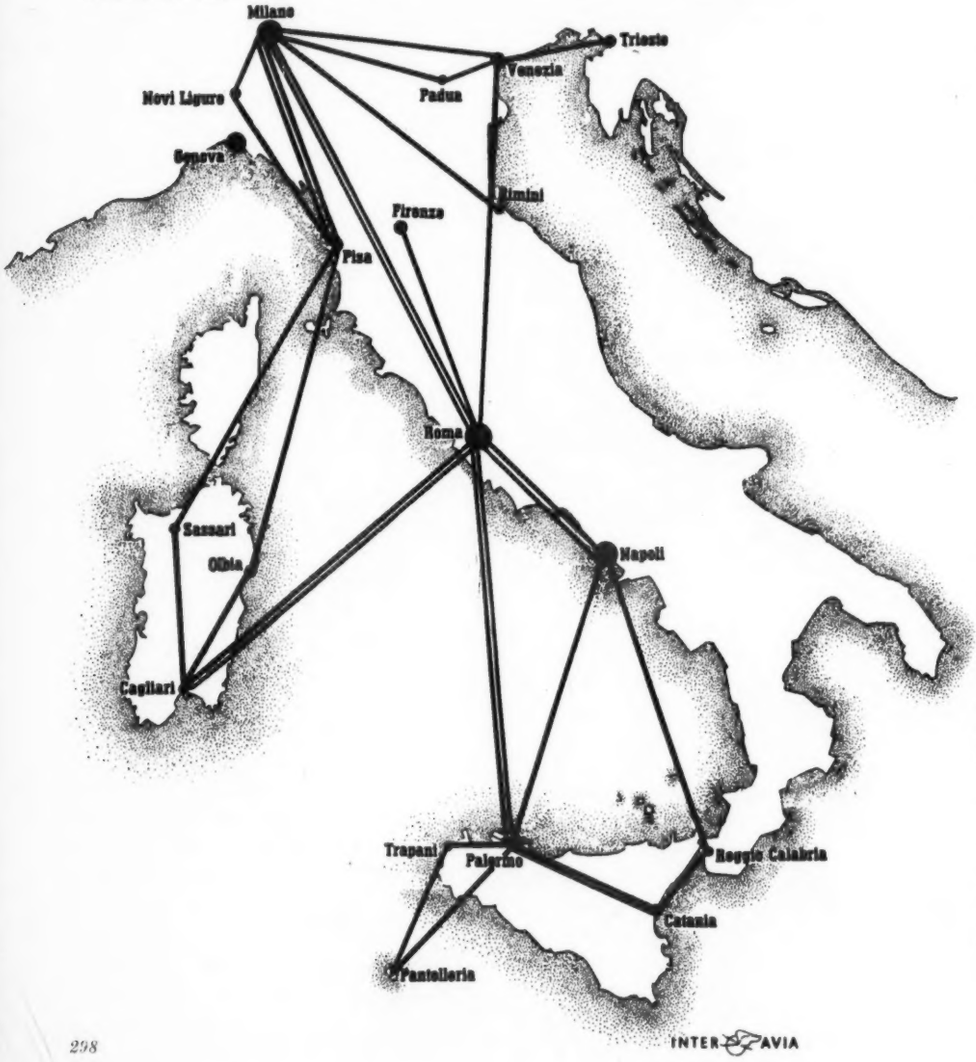
Italy's domestic air services

Linee Aeree Italiane

1. Rome - Palermo.
2. Rome - Cagliari.
3. Rome - Milan.
4. Milan - Venice.
5. Milan - Rome - Palermo - Catania.
6. Rome - Napoli - Palermo.
7. Palermo - Pantelleria.
8. Palermo - Trapani - Pantelleria.
9. Palermo - Catania.
10. Rome - Naples - Reggio Calabria - Catania.
11. Rome - Florence.

ALI-FLOTTE Riunite

12. Rome - Milan.
13. Rome - Venice - Gorizia (Trieste).
14. Rome - Padova - Venice.
15. Milan - Padova - Venice - Gorizia (Trieste).
16. Rome - Cagliari.
17. Rome - Olbia - Sassari.
18. Milan - Pisa - Sassari - Cagliari.
19. Milan - Pisa - Olbia - Cagliari.
20. Milan - Novi Ligure - Pisa (seasonal).
21. Milan - Rimini (seasonal).



Should the expected Alitalia-ALI Flotte Riunite merger go through, the Italo-British group will no doubt be much more powerful than the Italo-American concern. On the other hand, the British capital interest in the projected joint company will be drastically cut—to something between 10 and 25 percent.

In a technical respect the Italian airlines depend upon the Government's air registration board, the *Registro Aeronautico Italiano,* which supervises the airworthiness of the flying equipment. Ground facilities and air navigation aids are provided by the State.

Rome—Ciampino, the busiest airport in Italy, handled a total of 266,432 passengers in 1949, compared with a mere 227,822 and 185,198 steamship passengers for the country's largest seaports, Naples and Genoa. Every week 208 aircraft leave Ciampino for 150 destinations. According to the latest available figures, Ciampino recorded 2754 landings and take-offs in April, 1950. With a total of 47,811 passengers and 1,502,886 kilograms of cargo, baggage and freight. increases over the corresponding figures for April, 1949 by 33.3 percent and 89.9 percent, respectively, were obtained. In April alone the customs, post office and airport authorities collected nearly 850,000,000 lire in revenue from Ciampino.

In the order of the importance of traffic volume handled by them, there followed the airports of Rome—Urbe, Milan—Malpensa, Milan—Linate, Naples—Capodichino and a number of other large population centres, with the exception of Genoa, which does not yet possess its own airport, and Turin, whose facilities are inadequate for modern commercial air services. The latter two cities are endeavouring to raise the finance necessary to put into effect their airport projects, which are planned in every detail.

Lack of finance has so far prevented the implementation of large-scale, homogenous airport construction programmes. Improvisation had to be resorted to time and again to satisfy the most urgent requirements.

Plans exist, for instance, for an airport to be built at Fiumicino, northwest of Rome, the area and facilities of which would make it the economically most significant airport in the Mediterranean area. Total expenditure is estimated at 24,000,000,000 lire, but so far only 4,000,000,000 has been allocated for preparatory work.

The air safety services and the air navigation aids which, on the whole, conform to ICAO standards and recommend practices, are the responsibility of the Inspectorate of Telecommunications. Three Flight Information Regions, with headquarters at Brindisi, Rome and Milan, have been established, as well as numerous Air Traffic Control Regions : Milan, Venice, Rome, Naples, Brindisi, Catania and Cagliari. Finally, a series of Approach Control and Aerodrome Control centres has been created.

There is an extensive network of direction finding stations and radio beacons (including

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Alitalia's Rome agency.

directional beacons) for radio navigation and instrument flying purposes. Several Instrument Landing Systems (SCS 51) and Ground Controlled Approach stations are in operation. Planned is the installation of Omni-Ranges and Distance Measuring Equipment. Numerous meteorological centres and broadcasting stations also co-operate in providing air safety services.

The rescue organization, with headquarters is at Vigna di Valle, is equipped with landplanes, flying-boats and surface vehicles. Its numerous airfields and marine bases permit immediate search and rescue actions to be initiated in the entire territory of Italy.

Finally, mention should be made of the Institute of Aeronautical Medicine in Rome which, under Professor Guido Guida, provides free advice by radio to aircraft requiring medical assistance and in emergencies despatches ambulance aircraft with medical crews.

*

	ALITALIA			LAI			ALI-FLOTTE RIUNITE
	1947 (1)	1948	1949	1947 (2)	1948	1949	1949
Aircraft miles	398,580	1,791,630	1,953,090	910,380	1,957,860	2,373,010	1,931,240
Flying hours	—	—	—	5,731	12,410	12,870	12,454
Passengers	10,485	20,852	24,692	54,314	94,541	98,689	63,018
Baggage lbs.	318,300	959,880	1,256,580	—	—	—	200,990
Cargo lbs.	128,130	557,590	764,260	893,710 (3)	2,498,210 (3)	2,585,620(3)	1,841,640
Mail lbs.	39,050	131,880	223,310	102,360	209,250	219,770	89,880
Newspapers lbs.	32,790	126,770	223,790	—	—	—	265,640
Passenger miles	3,318,850	17,256,990	28,298,490	15,070,260	26,859,590	32,504,750	21,971,660
Ton-miles (U.S.)	—	—	—	1,587,700	2,916,800	3,626,700	—
Regularity	95.7 %	97.1 %	99 %	—	—	—	—

(1) From May 5, 1947 to Dec. 31, 1947. (2) From April 14, 1947 to Dec. 31, 1947. (3) Baggage and Newspapers included.

ALI-Flotte Riunite's offices in Rome.

No uniform equipment policy has so far been adopted by Italy's air transport system. American war surplus aircraft, which flooded the market after the war and could practically be bought for a song, favoured the formation of an astounding number of small companies. Even the major airlines bought surplus equipment, notably Douglas DC-3s. On the other hand, the British financial participation in one of the Italian airlines resulted in the purchase of Avro "Lancastrian" converted bombers for air transport purposes. The final result was that the only clients remaining to the Italian aircraft industry were the smaller companies operating short- and medium-stage service (Fiat three-engined and SIAI-Marchetti four-engined transports). The Breda-Zappata BZ.308, a large four-engined type, found no market, although its suitability for long-range commercial operations is undisputed (except for the Atlantic routes, for which pressurized cabins are now an essential requirement). And the pleas of the air carriers, who did not have the money to buy Italian aircraft, were simply ignored by the State.

On January 1st, 1950, Italy's commercial air fleet consisted of 103 transport aircraft and 34 aircraft operated by small firms (such as Ala Bianca, Alica, Borea) for training, taxi and other kinds of non-scheduled air work (dropping of advertising leaflets, etc.) which generally produces only modest revenue. Of 169 sports and personal aircraft, 109 were privately owned and 60 belonged to the aero clubs. Italy thus had a total of 306 civil aircraft, of which 120 were produced at home and 186 were imported.

The Aero Club of Italy (ACI), too, again deploys considerable activity. Headed by President Ing. Manillo Zerbinati, it unites all the provincial clubs, the autonomous clubs of the larger cities, the sailplane flying organizations, the aero-modellers groups, the Italian Aviation Technical Association, etc. ACI sponsors and co-ordinates the country's entire sports and private flying activities. It operates flying schools and runs training and refresher courses for more advanced students. Although it receives subsidies by the State, it is allowed unlimited freedom in its activities.

Italy's entire civil aviation at present is passing through a period of transition. This period will be concluded with a reorganization of the aviation authorities and with the establishment of a special civil aviation budget ensuring a harmonious expansion of the country's civil air fleet and network of scheduled air routes. Once this has been accomplished, the nation's economy will reap all those benefits which the 900 members of the Italian corporation of airmen, the "*Gente dell'Aria*," who served their country within the structure of the air carriers and on the airports, can offer it by contributing their share to Italy's growing part in the field of international civil aviation.

The Italian Aircraft Industry

BY ***

It is said that Brennus, the Gaulish chieftain, who in 387 B.C. penetrated as far as the Capitol of Rome, threw his sword into the scales weighing one hundred pounds of gold for the city's ransom with the exclamation, *Vae Victis*—Woe to the Vanquished! The Americans have adopted another principle. They, too, have thrown their sword into the scales. Italy, the vanquished nation, has joined the Atlantic Pact and is now being equipped with American arms. The gold needed to maintain the balance is being paid out by the Americans. They are financing not only the arms aid which the nation is receiving but also the substantial Marshall Plan supplies and grants to the Italian industry.

Coupled with the country's own initiative and vigour, this policy has resulted in rapid progress being made in the country's rehabilitation. The aircraft industry, too, is again quite enterprising, only seven years after the nation's "unconditional surrender." In 1945 the industry's adaptation to the initially very difficult post-war conditions brought about a notable reduction in the number of aircraft works. This process of selective elimination in the industry's struggle for survival has not yet run its course.

The major aircraft and air engine works, as well as numerous accessory manufacturers, combine to form a representative body, the Aviation Industries Association *(AIA: Associazione Imprese Aeronautiche)*, which maintains offices in Rome and Milan. President of AIA is *General Alfredo Bruno*, former Inspector-General of the Italian Air Force.

In addition to AIA, an aeronautical trading consortium, SICMAR (Società Italiana Commissionaria Materiale Aeronautico Roma) has been formed in Rome for the purpose of exercising a measure of control over the importation of foreign aircraft, engines and equipment in order to safeguard the industry's own interests. The Board of Governors comprises representatives of the Ministry of Defence and of the Alfa-Romeo, Fiat, Macchi and SAI-Ambrosini companies; Chairman again is General Bruno. SICMAR has been instrumental in the purchase of a series of British-built D.H. "Vampire" jet fighters for the Italian Air Force and also has acquired manufacturing rights to this type and its alternative power plants (D.H. "Goblin" and "Ghost") and all later developments (D.H. "Venom," etc.). The first batch of 50 "Vampires" will shortly be placed into production by Fiat in Turin and by Macchi at Varese.

AIRCRAFT MANUFACTURERS

BREDA

Considerable interest was aroused in the years immediately following the war by the aviation division of one of the largest Milanese industrial concerns, Società Italiana Ernesto Breda, which designed the *BZ.308* four-engined transport aircraft, an all-metal low-wing monoplane designed by the well-known *Engineer Filippo Zappata* and powered with Bristol "Centaurus" engines. The Argentine Government ordered several aircraft off the drawing-board and will shortly take delivery at least of the prototype, which made its initial flight in August 1948 and concluded its flying trials last year. Unfortunately, the concern, which suffered heavy losses as a result of the war, does not possess the funds required to put the aircraft into quantity production, and it is not very probable that the Government will provide the necessary finance. Meanwhile, the company has offered a military transport version, the BZ.312, powered with Pratt & Whitney R-2180 engines, to the Italian armed forces.

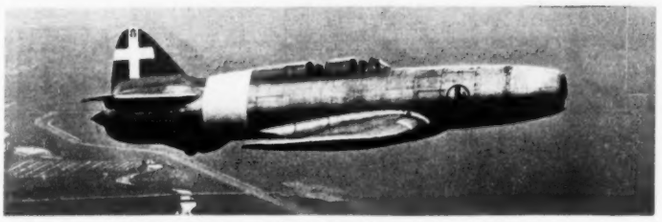
In addition, the Breda is about to complete a twin-engined all-metal commercial transport, the *BP.471* designed by *Mario Pittoni*, which is capable of carrying 18 passengers or about 3 tons of cargo. After a prolonged period of indecision concerning the power plant to be chosen, the aircraft has now definitely been equipped with Pratt & Whitney R-1830 "Twin Wasp" engines. Of interest is the inverted gull wing configuration, selected to facilitate emplaning and to reduce the landing gear height.

Type	Breda BZ. 308	Breda BP. 471
Engines	4 Bristol "Centaurus 568"	2 P. & W. R-1830-S1C3
Take-off power per engine	2500 h.p.	1200 h.p.
Span	138 ft. 5 in.	75 ft. 6 in.
Length	110 ft.	57 ft. 5 in.
Wing area	2,230 sq. ft.	587 sq. ft.
Max. take-off weight	102,500	21,160 lbs.
Max. landing weight	88,000	20,170 lbs.
Tare weight	59,500 lbs.	12,790 lbs. *
Max. speed	357 m.p.h. (at 21,000 ft.)	286 m.p.h. (at 10,000 ft.)
Speed at 60 % METO power	286 m.p.h. (at 11,000 ft.)	242 m.p.h. (at 11,500 ft.)
Stalling speed	—	78 m.p.h.
Service ceiling	26,250 ft. (at 102,500 lbs.)	25,500 ft. (at 21,160 lbs.)
Range	3300 mi.	1180 mi. (4920 lbs. payload)

* Tare weight of cargo version : 12,000 lbs.

In addition to the aircraft plant near Milan (Sesto San Giovanni), the Breda has concern a well-equipped works at Naples, *Industrie Meccaniche Meridionali*, a fully-owned subsidiary. The plant at present carries out only aircraft overhaul and repair work, but it is likely that a considerable proportion of the Milan factory's aircraft manufacturing activities will later be transferred to the Naples facilities.

Breda BZ.308 four-engined commercial transport (Bristol "Centaurus" engines).



1941 : Caproni-Campini experimental jet aircraft.

Caproni Ca.193 all-metal five-seater (two Walter "Minor" engines).

CAPRONI

The Gruppo Caproni, formed in 1910, comprised about fifty aircraft, engine, parts and equipment plants before the last war. Many of the factories were destroyed by bombing raids or as a result of the tough fighting in Southern and Central Italy. Others became independent after the war, and most of them engaged in non-aviation manufacturing activities. Recently, at the beginning of 1950, the original *Aeroplani Caproni* company at Milan-Taliedo failed financially after several years of struggle and went into bankruptcy. The entire aviation activity of the former giant concern is now concentrated in a relatively modest company, *Caproni Aeronautica Bergamasca,* of Ponte San Pietro, Bergamo. Repair work on a small scale is also carried out by *Aero Caproni Trento,* of Gardolo, near Trento.

The only post-war design produced by Caproni is the *Ca. 193* twin-engined, all-metal 5-seater prototype powered with 150 h.p. Walter "Minor 6" engines driving Ratier "Heramatic" controllable-pitch pusher airscrews. The designer of this attractive mid-wing tricycle aircraft is *Amilcare Porro.*

Dimensions and weights : Span, 45 ft. 3 in. ; length, 29 ft. 6 in. ; wing area, 220 sq.ft. ; gross weight, 4,410 lbs. ; tare weight, 2,865 lbs. *Performance :* Maximum speed, 186 m.p.h. ; landing speed, 65 m.p.h. ; service ceiling, 18,700 ft. ; range, 750 miles.

Finally, the Caproni group has reverted to its old pioneering activity in the field of jet-propulsion and has started work on a project for a single-seater trainer designated *Ca.195* featuring two small turbines (of 880 lb. static thrust each), mounted to the fuselage sides. — The Caproni-Campini jet-propelled experimental aircraft illustrated on this page (engine-driven compressor and after-burner) flew from Milan to Rome in November, 1941. It was not very fast but it showed the practical possibilities of an idea.

FIAT

The *Aeritalia Division,* of Turin, has been a component of the Fiat concern since 1926 and is regarded as one of the best-equipped in Europe. Fiat's activities in the aircraft engine field date farther back, for it was in 1908 that the first Fiat aircraft power plants were manufactured, and during World War I the concern produced more than 15,000 aircraft engines.

At the beginning of the thirties, Fiat began to manufacture metal wing and fuselage structures, although it retained fabric covering for the time being. Within a limited period ot time, the CR.20, CR.32 and CR.42 fighter biplanes and the BR.20 twin-engined low-wing bomber monoplane designed by *Celestino Rosatelli* became well-known the world over. More than 1200 CR.32 fighters, powered with air-cooled Fiat A.30 engines, nearly 1800 CR.42 fighters with air-cooled Fiat A.74 engines, and approximately 600 BR.20 bombers with Fiat A.80 engines were produced.

As long ago as 1937 the Turin concern built an all-metal fighter low-wing monoplane. This was the *Fiat G.50,* which, like all recent Fiat types, was designed by *Professor Ing. Giuseppe Gabrielli.* Fitted with a Fiat A.74 radial engine, the output of which was gradually boosted from 800 h.p. to 840 h.p., the G.50 was extremely robust and achieved noteworthy climb and level speed performances. Several hundred aircraft of the type (G.50 bis) were delivered in the first years of the war. At the same time, the aircraft was further developed by the installation of liquid-cooled engines. Of the prototypes which were studied (G.50V with Daimler-Benz 601 engine ; G.55 with Daimler-Benz 605 ; and G.56 with D.B. 603) only the G.55 was placed into quantity production in 1942.

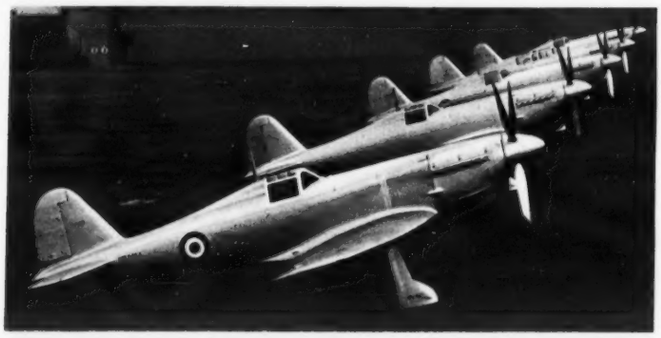
Apart from these fighters, Professor Gabrielli created several personal and touring aircraft as well as a number of twin- and three-engined

Plant of Aeritalia Division of the Fiat concern, Turin.

Fiat G.212 CP "Monterosa" all-metal commercial transport (three P & W "Twin Wasps").

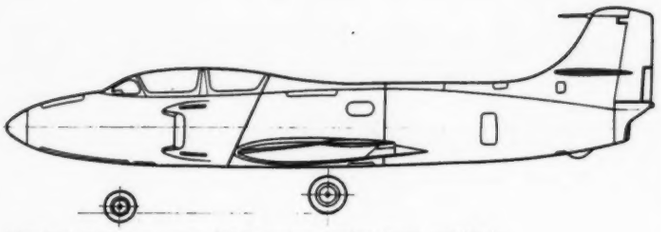
Fiat G.46 all-metal trainer of the Italian Air Force (Alfa 115 engine).

Fiat G.59B two-seater fighter trainer (Rolls-Royce "Merlin" engine).



Fiat G.59A single-seater fighter-trainers ready for delivery (Rolls-Royce "Merlin").

Fiat G.212 TP three-engined transport over the Alps.



The Fiat G.80 two-seater fighter-trainer project D.H. "Goblin").

commercial transports powered with radial engines. Amongst the twin-engined designs mention may be made of the G.18 (which had Fiat A.59 engines of 700 h.p. each) of 1935 and the G.18V (with Fiat A.80 engines of 980 h.p.) of 1937. Three-engined models were the G.12C, which was designed after 1940 and is still in active service (15 passengers) and the G.12L for 18 to 22 passengers. Both types are equipped with three 770 h.p. Fiat A.74 engines. All commercial types were built entirely of metal.

The post-war difficulties were overcome fairly rapidly owing to the company's organizational and financial strength, as well as owing to the intensive, profitable operation of the automobile-manufacturing division. This applies not only to the Aeritalia Aircraft Division but also to the Lingotto aero-engine division in Turin and to Costruzioni Meccaniche Aeronautiche, of Marina di Pisa, a fully-owned subsidiary which, for the time being, is engaged in non-aviation manufacturing activities.

The concern began its post-war aeronautical career by completing a modest series of G.12L three-engined transports. Some of these were equipped with new engines (Bristol "Pegasus 48" of 720 h.p. and P&W "Twin Wasp" of 1050 h.p.) and sold to various airline companies over the past few years. Similarly, the G.55 (Fiat RA 1050) and the G.59A (Rolls-Royce "Merlin 24") single-seater trainers, the G.55B (Fiat RA 1050) and G.59B (Rolls-Royce "Merlin T 24") two-seater trainers * were developed for the Italian Air Force from the G.55 single-seater fighter (DB 605), of which a total of 105 machines had been delivered during the war, and of which a large quantity of parts and spares was available when the war ended.

Very soon the company turned to the design of new types, namely, the G.212 three-engined commercial transport and the G.46 two-seater trainer. Both types were built in several sub-versions.

The new *G.212 CP "Monterosa"* 26-34 passenger commercial transport was derived from the G.12L but was provided with a wider and longer fuselage. It is powered with P&W R-1830 "Twin Wasp" radials. The *G.212 TP "Monviso"* cargo version, equipped with the same engines, is in service as a military transport and as a civil cargo aircraft. In addition to these, there is a luxury version and a military trainer model, the G.212 "Aula Volante."

The *G.46* trainer, an all-metal low-wing monoplane with tandem seats and retractable landing-gear, is at present being produced in considerable numbers for the Italian and Argentine air forces. The type is equipped either with 220 h.p. Alfa-Romeo 115ter or with 250 h.p. de Havilland "Gipsy Queen 30" engines and fitted out with complete blind-flying instruments and VHF radio-telephone equipment. Normally of two-seater configuration (G.46-2 and G.46-3B), the type is optionally available also as a single-seater (B.46-3A).

In contrast to the successful conversion of the G.12 into the G.212, the project of changing the twin-engined pre-war G.18 (for 18 passengers) into modern medium-stage commercial transport designated *G.218* (pressurized cabin for 24-32 passengers, nose-wheel landing-gear) has not progressed beyond the design stage. — In recent months

* Several other power plant variations were considered, such as the air-cooled Isotta-Fraschini "Delta RC 40" (models G. 48 A and B) and the Rolls-Royce-Packard "Merlin V-1650" (models G. 61 A and B).

negotiations have taken place between Fiat and Svenska Aeroplan A.B. for the production under licence in Italy of the Swedish SAAB 90 A-2 "Scandia" twin-engined passenger airliner.

In the meantime the Fiat concern has gained a foothold also in the field of jet-propulsion. The Aeritalia Division will produce the de Havilland "Vampire" jet fighter for the Italian air force under licence ; the Lingotto aero-engine plant is to produce the necessary power units. At the same time Fiat is working on a two-seater jet fighter of its own design which probably is intended primarily for training purposes.

This aircraft, again designed by Professor Gabrielli and designated *G.80,* is to have a D.H. "Goblin 4" jet of 3500-lb. static thrust mounted in the fuselage centre. It is to have lateral engine air intakes. The pilot occupies the forward cockpit, the instructor-observer the rear seat. Ejector seats will be provided for both cockpits.

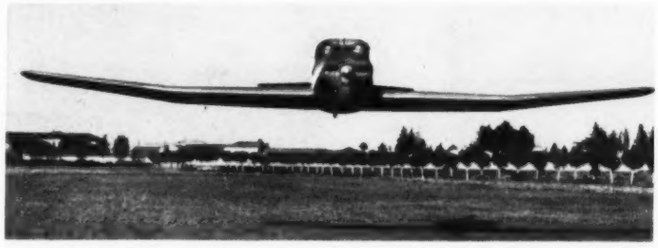
Type	G. 212 CP	G. 46-3B	G. 59A	G. 59B	Project G. 80
Power plant	3 P. & W. R-1830 SIC3-G	Alfa 115 ter	R.-R. "Merlin" T 24-2	R.-R. "Merlin" T 24-2	D.H. "Goblin 4"
Take-off power	1200 h.p.	220 h.p.	1610 h.p.	1610 h.p.	3500 lbs. static thrust
Span	96 ft. 3 in.	34 ft. 2 in.	38 ft. 11 in.	38 ft. 10 1/2 in.	—
Length	75 ft. 7 in.	27 ft. 10 in.	31 ft. 1 in.	31 ft. 1 in.	—
Wing area	1255 sq. ft.	172 sq. ft.	227 sq. ft.	227 sq. ft.	app. 290 sq. ft.
Take-off weight	39,680 lbs.	3060 lbs.	8420 lbs.	7630 lbs.	11,000 lbs.
Tare weight	24,690 lbs.	2330 lbs.	6085 lbs.	6000 lbs.	8,150 lbs.
Max. speed	236 m.p.h. (at 12,000 ft.)	194 m.p.h. (at S.L.)	373 m.p.h. (at 24,600 ft.)	373 m.p.h. (at 24,600 ft.)	545 m.p.h. (at S.L.)
Stalling speed	78 m.p.h.	72 m.p.h.	106 m.p.h.	99 m.p.h.	99 m.p.h.
Service ceiling	24,600 ft.	19,700 ft.	34,450 ft.	36,100 ft.	43,300 ft.
Max. range	1710 mi.	620 mi.	610 mi.	515 mi.	840 mi.

LOMBARDI

Francis Lombardi, who served as a fighter pilot in World War I and who in the between-wars period became a well-known aircraft designer and sporting flying pioneer, for the past ten years has operated a relatively small company at Vercelli airport, in the Piedmont. His first type, the *"Avia FL.3"* two-seater all-wood low-wing cabin monoplane, which had a "CNA-D4" engine of 60 h.p., was an undisputed success. As one of the most economical training and sporting aircraft of its period, the FL.3 acquired a reputation all over Europe. Several hundred machines of the type—a record for Italy—were built and operated in Italy, Yugoslavia and Germany.

After the war the company created the *LM.5 "Aviastar"* two-seater sporting aircraft. Powered with the same engine as the FL.3 and also built entirely of wood, the LM.5 has a somewhat smaller span but features landing flaps and retractable landing-gear. Consequently, it is considerably faster than its predecessor.

Dimensions and weights : Span, 36 ft. 5 in. ; length, 20 ft. 3 in. ; wing area, 156 sq.ft. ; gross weight, 1,145 lbs. ; tare weight, 660 lbs. *Performance :* Maximum speed, 118 m.p.h. ; landing speed, 37 m.p.h. ; service ceiling, 1300 ft. ; endurance, 5 hours.



Lombardi LM.5 "Aviastar" two-seater sports aircraft in high speed and in low speed flight (60-h.p. engine).

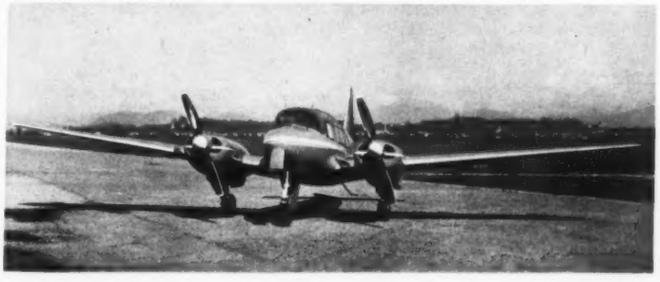
MACCHI

Founded in 1912, Aeronautica Macchi S.A., of Varese, soon acquired an international name through a series of altitude and speed records. The MC.72 seaplane created by *Mario Castoldi* (powered with a 3100-h.p. dual engine driving contra-rotating propellers) still holds the FAI's international seaplane speed record which Lieutenant Agello established over Lake Garda in the autumn of 1934 at 709.2 kilometres per hour. At the beginning of World War II, Macchi brought out the first Italian high-speed fighters, the MC.200, MC.202 and MC.205, which gradually replaced the slow biplanes of the Italian Air Force.

After the war, *Ermanno Bazzocchi* joined the company as chief designer. Whilst the company ensured the daily livelihood of its labour force by producing the "Macchitre" three-wheel delivery vans and automobile trailers, Bazzocchi quietly began work on the designs for a two-seater and a six-seater aircraft. Their success was considerable, and at the end of 1947 the two-seater model was put into production. A small contract for the six-seater is expected from the Italian armed forces in the near future.

The *MB.308* two-seater, an all-wood cantilever high-wing monoplane powered with a Continental C.65, C.85 or C.90 engine, is available either with a fixed nose-wheel landing-gear or with floats and

Prototype of the Macchi MB.320 twin-engine six-seater touring and training aircraft (Continental E.185 engines).



The Macchi MB.308 was put into quantity production shortly after the war.

Macchi MB.308 two-seater sports seaplane (Continental C.90 engine).

features full flaps. The cantilever design offers an advantage particularly in the seaplane model, since it facilitates emplaning, alighting and mooring. The *MB.320* six-seater prototype is a low-wing monoplane and is also built of wood but has a metal fuselage nose. It is powered with two Continental E.185 engines of 185 h.p. ; constant speed airscrews, landing flaps, retractable under-carriage and blind-flying equipment, VHP and HF radiotelephony equipment, radio compass, and even with a pneumatic auto-pilot weighing only 18 lbs. (Sperry ALI).

Type	MB. 308 Landplane	MB. 308 Seaplane	MB. 320 Landplane
Engine : Continental	C. 90	C. 90	E. 185
Airscrew	Feste LS.	Aeromatic	Aeromatic
Take-off power per engine	90 h.p.	90 h.p.	185 h.p.
Span	32 ft. 10 in.	32 ft. 10 in.	42 ft. 8 in.
Length	21 ft. 5 in.	21 ft. 9 in.	28 ft. 5 in.
Wing area	148 sq. ft.	148 sq. ft.	227 sq. ft.
Take-off weight	1430 lbs.	1520 lbs.	4960 lbs.
Tare weight	900 lbs.	1040 lbs.	3280 lbs.
Max. speed	126 m.p.h.	124 m.p.h.	200 m.p.h.
Landing speed	42 m.p.h.	43 m.p.h.	67 m.p.h. *
Service ceiling	16,500 ft.	15,500 ft.	17,000 ft.
Max. range	450 mi.	460 mi.	1000 mi.

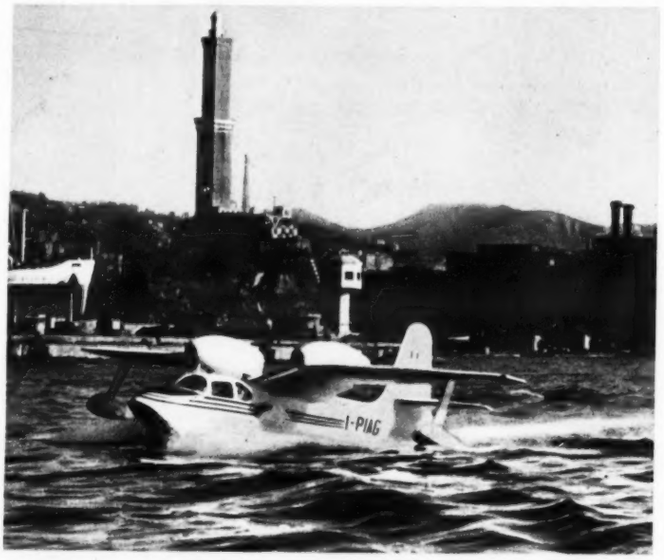
* Stalling speed with flaps down.

PIAGGIO

Piaggio & Co., of Genoa, with branch factories at Finale Ligure, Pisa and Pontedera, has engaged in the manufacture of airframes and aero-engines since 1915. The company developed a range of seaplanes and twin- and four-engined bombers, mostly to the designs of *Giovanni Casiraghi*. The majority of them were powered with single- and twin-row radial engines of the firm's own manufacture. The most powerful engine, the 18-cylinder P.XV-RC 60/2V, developed 1500 h.p. at 16,000 ft. After the war the company realized that the manufacture of motor-scooters would bring higher profits, and today the Pontedera engine plant is engaged almost exclusively in the production of the popular "Vespa." The overhaul of aircraft engines and the manufacture of controllable-pitch propellers now is of secondary importance.

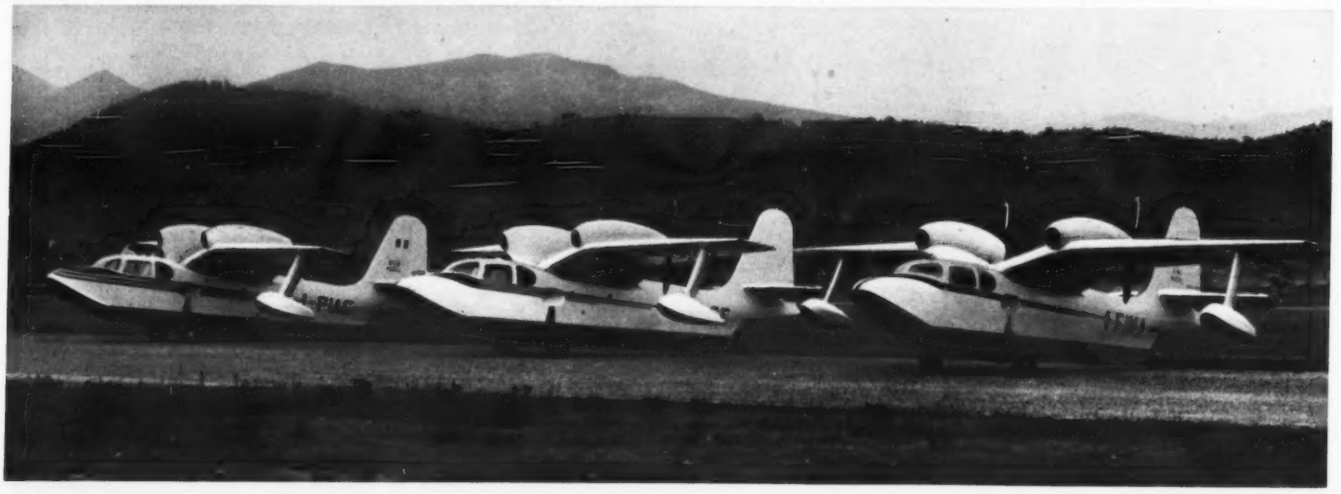
The airframe plant at Finale Ligure, on the other hand, has remained loyal to the company's aeronautical tradition and brought out the *Piaggio P.136* twin-engined five-seater all-metal amphibian some time after the war. It is powered with 215-h.p. Franklin 6A8-215-B9F engines driving controllable-pitch pusher airscrews. Both on land and on water it has excellent take-off characteristics as well as good all-round climb and speed performance.

Dimensions and weights : Span, 44 ft. 3 in. ; length, 35 ft. 5 in. ; wing area, 258 sq.ft. ; gross weight, 5400 lbs. ; tare weight, 3850 lbs. *Per-*



Piaggio P.136 in its third element.

Amphibians like the Piaggio P.136 five-seater all-metal type (two 215 h.p. Franklin engines) are particularly suitable for joy trips over the Italian Peninsula.



formance : Maximum speed at sea level, 172 m.p.h. ; stalling speed, 71 m.p.h. ; service ceiling, 16,500 ft. ; take-off run, 1000 ft. ; take-off from water in 24 secs. ; range, 750 miles with a 660-lb. payload.

A two-seater trainer designated *P.143,* an all-metal low-wing monoplane with 215-h.p. Franklin 6A8 engines and retractable tail-wheel landing-gear, is now in the design stage.

Finally, the *P.108* four-engined bomber and cargo transport, an all-metal design dating back to 1938-1943, might be revived as a cargo aircraft called *P.140.* Present design projects provide for a modified fuselage and the installation of a nose-wheel landing-gear. Power plant would be four Bristol "Hercules 761" engines of 1950 h.p. each for take-off. The take-off gross weight is estimated as 82,500 lbs., the payload as 26,500 lbs. for a 625-mile range or 11,700 lbs. for a 2,500-mile range.

SAI — ING. A. AMBROSINI & CO.

Società Aeronautica Italiana (SAI), whose registered offices are in Rome, headquarters in Milan and plant at Passignano, near Perugia, was consolidated with the concern of *Ing. A. Ambrosini & Co.* in 1934 but soon became renowned through a series of successful touring, racing and fighter aircraft. Chief designer was *Sergio Stefanutti.*

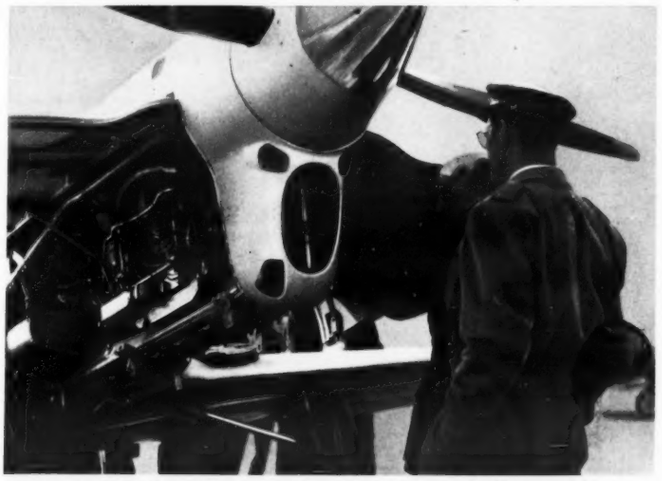
The pre-war *SAI Ambrosini S.7* two-seater high speed aircraft still holds the international speed record over 100 kilometres for aircraft of Category I (6.5 to 9 litres) which it established in 1939 with a speed of 392.6 kilometres per hour. From this type the *SAI* 207 fighter was developed during the war. In dives this aircraft attained an indicated air speed of 466 m.p.h. at 10,000 ft., representing a true air speed of 596 m.p.h. or Mach .86. The youngest member of the family is the *Ambrosini S.7* which was designed in 1949 and features a 220-h.p. Alfa 115 engine and hydraulic c.p. airscrew. The aeroplane has a maximum speed of 227 m.p.h. in level flight and a diving speed limitation of between 500 to 530 m.p.h. At present it is in production as a single- and as a two-seater military transitional training type. A two-seater prototype already has started its flying trials ; the first single-seater was completed in March 1950. Both versions have full blind-flying equipment and VHF radio-telephone, and the single-seater also carries practice guns and a gun-camera. The graceful low-wing monoplane is built entirely of wood and has hydraulically retractable main wheels.

Another of Stefanutti's recent creations, the *S.1001 "Grifo"* four-seater personal aeroplane, was built in a small series already a short while after the end of the war. In April, 1948, an aircraft of this type made a non-stop flight from Udine to Massawa (2,600 miles in 24 hours) and in January, 1949, a staging flight from Milan to Buenos-Aires. The "Grifo" is a wooden low-wing monoplane powered with a 145-h.p. Alfa 110 and has a fixed landing-gear. From the S.1001 a two-seater trainer with a somewhat greater span has been derived in a landplane and a seaplane version. The model, designated *S.1002 "Trasimeno,"* is expected to begin its test flights shortly.

To the Ambrosini group also belongs the *Aeronautica Sicula* plant at Palermo, in Sicily. At present engaged in repair work, this autonomous subsidiary hopes to be awarded sub-contracts for the D.H. "Vampire" production programme, since recent legislation provides that one-sixth of all Government orders must be placed in the South of Italy.

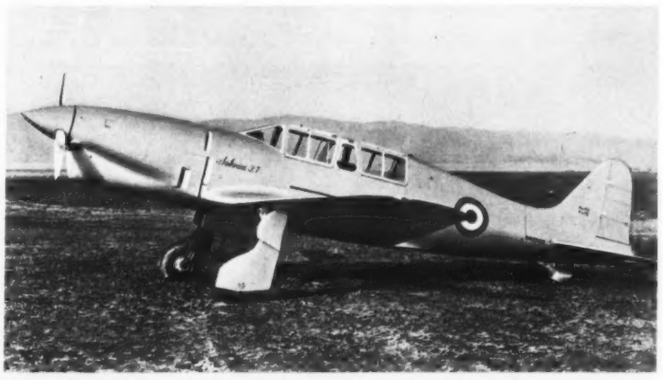
Type	SAI. S. 7 Two-seater	SAI. S. 1001 Landplane	SAI. S. 1002 Seaplane
Engine	Alfa 115	Alfa 110	Alfa 110
Take-off power	220 h.p.	145 h.p.	145 h.p.
Span	28 ft. 7 in.	32 ft. 6 in.	35 ft. 10 in.
Length	26 ft. 10 in.	25 ft. 7 in.	25 ft. 7 in.
Wing area	138 sq. ft.	164 sq. ft.	170 sq. ft.
Gross weight	3035 lbs.	2335 lbs.	2445 lbs.
Tare weight	2240 lbs.	1540 lbs.	1740 lbs.
Max. speed	227 m.p.h.	149 m.p.h.	130 m.p.h.
Stalling speed	68 m.p.h.	59 m.p.h.	53 m.p.h.
Service ceiling	17,000 ft.	16,500 ft.	15,000 ft.
Max. range	620 mi.	530 mi.	620 mi.

The SAI-Ambrosini S.1001 "Grifo" (Alfa 110) carried out several sensational long distance flights.



Close-up of the 220 h.p. Alfa 115 engine and the hydraulic landing gear of the new Ambrosini S.7.

The prototype of the new Ambrosini S.7 (two-seater version).



SIAI — MARCHETTI

Since its formation in 1915, Società Italiana Aeroplani Idrovolanti Marchetti has spread out to some of the prettiest spots along the shores of Lago Maggiore, in one of the most beautiful regions of Northern Italy. The main factory is situated at Sesto Calende, a branch works is at Borgomanero, and the final assembly plant and the factory airfield are at Vergiate. In the 'twenties the company produced a number of successful flying-boats, of which the 1,500-h.p. S.55 twin-engined twin-hull flying-boat was the most famous. Twelve aircraft of this type under the command of General Italo Balbo carried out a formation flight from Rome to Rio de Janeiro in 1931. In 1933 twenty-four of these flying-boats, again commanded by General Balbo, crossed the North Atlantic in both directions on a flight leading them from Rome to Reykjavik, Chicago, the Azores and back to Rome. Several years before these memorable flights, the Marquis De Pinedo flew his S.55 around the Atlantic shores from Rome to Buenos Aires, to Chicago and the Azores and back to Rome. In the 'thirties a number of three-engined commercial landplanes and bombers were added to the flying-boats. These were the SM.75 for 24 passengers, the SM.79 reconnaissance bomber and the SM.83 for 10 passengers and cargo. The transports flew on all Italian routes in Europe and Africa (Ala Littoria) as well as in South America and on the South Atlantic (LATI). All models were either of composite construction (mostly with steel tubular fuselage structure) or, as in the case of the flying-boats, entirely of wood.

SIAIS's post-war commercial types are twin- or four-engined, and they continue to be of composite construction (SM.102 and SM.95). A projected twin- or four-engined cargo transport (SM.105) was to be of all-metal construction but never got beyond the drawing-board stage. In addition, the company developed a single-engined six-seater personal aircraft, the SM.101, which again was of metal-and-wood construction.

SIAI-Marchetti SM.102 feeder transport for 8 to 10 passengers (two P & W "Wasp Juniors").

Of all these types only the SM.95 four-engined long-range transport was built in a limited series and supplied to Alitalia and to the Anglo-Egyptian SAIDE airline. Equipped with Pratt & Whitney "Twin Wasp" engines (other radial types have also been fitted), it accommodates 30 passengers. The SM.102 twin-engined feeder transport for 8 to 10 passengers has in the meantime been given Pratt & Whitney "Wasp Junior" radials in place of its earlier in-line engines.

In addition to its aircraft manufacturing programme, which is slowly gathering momentum, and the manufacture of controllable pitch propellers of its own designs (Idrovaria), SIAI also produces railway trucks, motorbus bodies, speedboats and bicycles.

Type	SM. 95	SM. 101	SM. 102
Engine	4 P. & W. R-1830	Walter "Bora R"	2 P. & W. R-985
Take-off power per engine	1200 h.p.	230 h.p.	450 h.p.
Span	122 ft. 5 in.	54 ft. 2 in.	59 ft. 1 in.
Length	81 ft. 3 in.	33 ft. 4 in.	41 ft. 0 in.
Wing area	1380 sq. ft.	322 sq. ft.	437 sq. ft.
Gross weight	52,900 lbs.	5200 lbs.	11,140 lbs.
Tare weight	32,000 lbs.	3530 lbs.	7610 lbs.
Max. speed	242 m.p.h. (at 10,000 ft.)	150 m.p.h. (at S.L.)	208 m.p.h. (at 3300 ft.)
Cruising speed at 60% METO-power	214 m.p.h. (at 11,500 ft.)	127 m.p.h. (at 5700 ft.)	180 m.p.h. (at 11,500 ft.)
Service ceiling	22,300 ft.	13,800 ft.)	18,000 ft.
Max. range	1870 mi.	750 mi.	680 mi.
Equivalent payload	9000 lbs.	800 lbs.	2000 lbs.

Several SIAI-Marchetti SM.95 four-engine thirty-passenger long-range transports are in service on the scheduled air routes (Alfa Romeo or Pratt & Whitney radial engines).

SIAI-Marchetti SM.101 six-seater touring aircraft (Walter "Bora" engine).

OTHER AIRCRAFT MANUFACTURERS

Several member companies of the Italian Aircraft Industries Association turned to non-aviation manufacturing activities after 1945. These were notably CANSA at Cameri-Novarra, CANT at Monfalcone and REGGIANE at Reggio-Emilia. Others have stuck to their guns but have produced no new designs since the end of the war. To the latter category belongs the NARDI company of Milan which, prior to 1940, became famous as the manufacturer of several racing aircraft but today seems to concentrate on the more profitable production of landing-gear units and also represents Bendix International in Italy. MAGNI, also of Milan, built a prototype of its "Aerauto" roadable high-wing pusher monoplane on behalf of *Signor Pellarini*. This all-metal aircraft has frequently been in the news since its first flight in May 1948. — SACA (S.A. Costruzioni Aeronavali), of Brindisi, has

PL.5C "Aerauto" roadable all-metal two-seater by Pellarini (Continental C.85 engine).

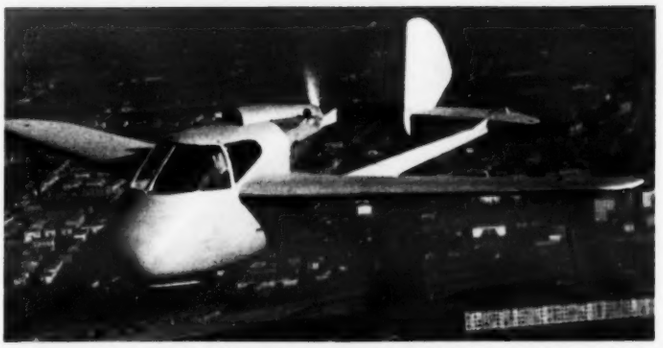
started the manufacture under licence of the Saiman 202 two-seater low-wing cabin monoplane, an all-wood design of S.A. Industria Meccaniche Aeronautiche Navali, of Rome, dating back to 1937. The aircraft has an Alfa 110 engine and a fixed undercarriage.

The old-established firms have in recent years been joined by several small workshops and a host of young, ambitious and frequently quite unconventional designers. These small outfits do not yet belong to the Aircraft Industries Association but have nevertheless built a number of light and ultra-light aircraft prototypes, some of which look quite attractive.

Among these, mention must be made of the small but very active ALAPARMA company, of Parma, and its AM.65 and AM.75 "Baldo" models designed by *Adriano Mantelli* and *Pietro Callerio* (predecessor type : AM.8, AM.9 and AM. 10). These wooden two-seater mid-wing monoplanes, powered with a 65-h.p. and a 75-h.p. engine respectively, driving pusher airscrews, have a wing-span of 23 ft. and a single main wheel, assisted by auxiliary skids under the wings. The tail unit can be folded back over the cabin, so that the aircraft can be housed in any garage and, loaded span-wise, towed to and from the airfield by a passenger car and a two-wheel trailer. The new ALI VIBERTI aircraft division of the Officine Viberti vehicle works of Turin has built the 60-h.p. "Musca 1" two-seater low-wing monoplane to the designs of *Franco Muscariello* ; the principal characteristic of the aircraft is its unusually large panorama canopy. —Two fast cabin low-wing monoplanes with retractable nose-wheel landing-gear have been created by *Ermenegildo Preti* of Milan Institute of Technology. They are the *P.110* three-seater and the *PM.280* "*Tartuca*" single-seater. The three-seater was built at Gallarate in the small shop of Giovanni AGUSTA, the veteran aircraft designer, and equipped with a 145-h.p. Alfa 110 engine and c.p. airscrews ; the single-seater, which has a 60-h.p.—CNA engine, was constructed in the shops of Milan Institute of Technology.—Finally, the small workshops of MOVO (Modelli Volanti), of Milan, have completed single- and two-seater ultra-light aeroplanes designated *MF.1* "*Passero*" and *MF.2* "*Bi-passero*" which can be equipped, as desired, with a 20-h.p., 45-h.p. or 65-h.p. horizontally opposed engine. The designer of these aircraft, which look like powered gliders but are not suitable for gliding purposes, is *Stelio Frati*.

Type	Alaparma AM. 65 "Baldo"	Viberti "Musca 1"	Augusta Preti P. 110	T.H. Mailand Preti PM. 280	Movo MF. 1 "Passero"
Engines	Walter "Mikron"	CNA D. 4	Alfa 110	CNA D. 4	Continental C. 65
Take-off power	65 h.p.	60 h.p.	145 h.p.	60 h.p.	65 h.p.
Span	23 ft. 0 in.	31 ft. 2 in.		16 ft. 5 in.	23 ft. 0 in.
Length	17 ft. 1 in.	22 ft. 8 in.		16 ft. 5 in.	16 ft. 5 in.
Wing area	—	150 sq. ft.		54 sq. ft.	84 sq. ft.
Gross weight	925 lbs.	1320 lbs.		770 lbs.	680 lbs.
Tare weight	485 lbs.	815 lbs.		—	—
Max. speed	137 m.p.h.	109 m.p.h.		162 m.p.h.	143 m.p.h.
Min. speed	40 m.p.h.	47 m.p.h.		53 m.p.h.	47 m.p.h.
Service ceiling	—	13,100 ft.		—	9,800 ft.
Max. range	450 mi.	350 mi.		—	310 mi.

The only company which has so far taken a foothold in the *helicopter field* is the firm headed by *Count Manzolini*, of Rome, which has completed an experimental helicopter designated "*Libellula*." The aircraft has co-axial contra-rotating two-blade rotors measuring 26 ft. in diameter. Designers were *Bordoni* and *Gianini*. The helicopter has been given the type designation BGM-2, no doubt in order to satisfy the pride of all concerned. Tie-down tests with a 75-h.p. engine were carried out some weeks ago. It is likely that a more powerful engine will finally be fitted, since the prototype already is built as a two-seater.



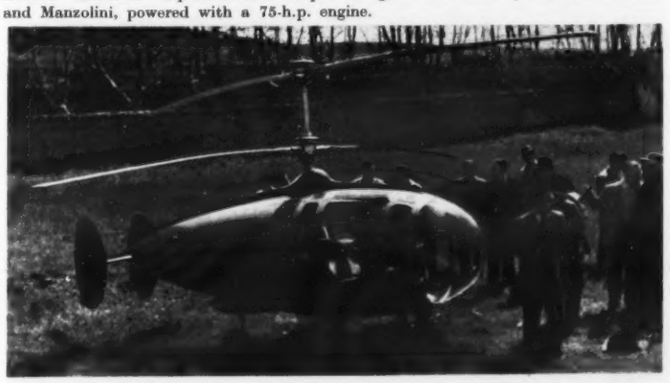
Alaparma AM.65 "Baldo" ultra-light aircraft (Walter "Mikron" engine).

Movo MF.1 "Passero" ultra-light aircraft (Continental C.65 engine).

Ali Viberti "Musca 1" two-seater sports aeroplane (60-h.p. CNA engine).

The Preti P.110 three-seater touring aircraft built by Agusta (Alfa 110 engine), and its designer.

BGM-2 "Libellula" experimental helicopter designed and built by Bordoni, Gianini and Manzolini, powered with a 75-h.p. engine.



Leaders of the Italian Aircraft Industry

Ing. *Angelo Ambrosini*, Chairman of the concern bearing his name.

General *Alfredo Bruno*, President of AIA, the Italian Aircraft Industries Association, and of the SICMAR aeronautical trading consortium.

Gianni Caproni, Count of Taliedo, until recently Managing Director of the Caproni concern.

Ing. *Giovanni Casiraghi*, designer of all recent aircraft types built by Piaggio & Co.

Ing. *Paolo de Ambrosis*, Engineering Manager for Società Aeroplani Idrovolanti Marchetti.

Professor *Giuseppe Gabrielli*, Engineering Director and Chief Designer for the Fiat concern. Designer of all Fiat aircraft designated by the letter "G."

General *Eraldo Ilari*, Managing Director of Aeronautica Macchi.

Ing. *Alessandro Marchetti*, Managing Director and Chief Designer for Società Aeroplani Idrovolanti Marchetti.

Franco Muscariello, designer of the Ali Viberti "Musca 1" two-seater sports aircraft.

Ing. *Armando Piaggio*, Managing Director of the Piaggio & Co. aircraft and engine company.

Ing. *Mario Pittoni*, Designer of the Breda BP.471 twin-engined commercial transport.

Ing. *Amilcare Porro*, designer of the Caproni Ca.193 six-seater personal transport aircraft.

Ing. *Sergio Stefanutti*, Engineering Director for Società Aeronautica Italiana Ing. A. Ambrosini & Co.

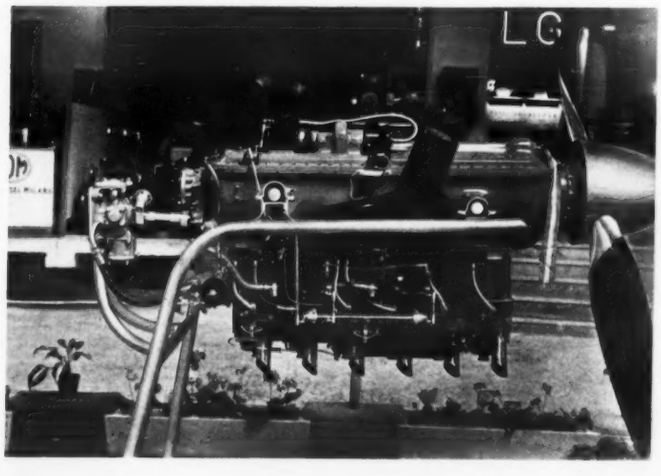
Professor Ing. *Vittorio Valletta*, Chairman of the Fiat concern.

Ing. *Filippo Zappata*, designer of the Breda BZ.308 four-engined commercial transport.

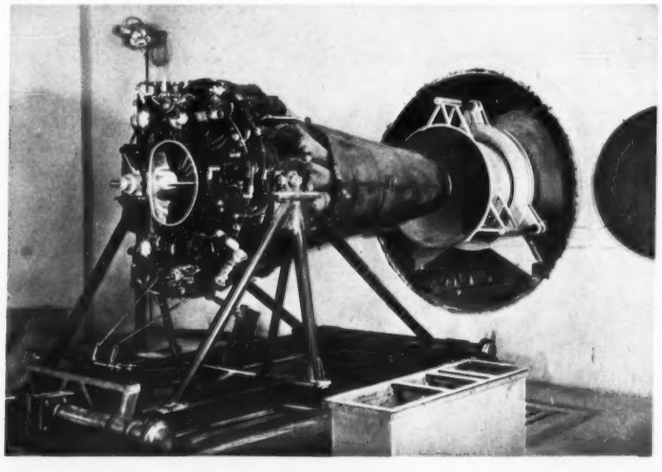
AIRCRAFT ENGINE MANUFACTURERS

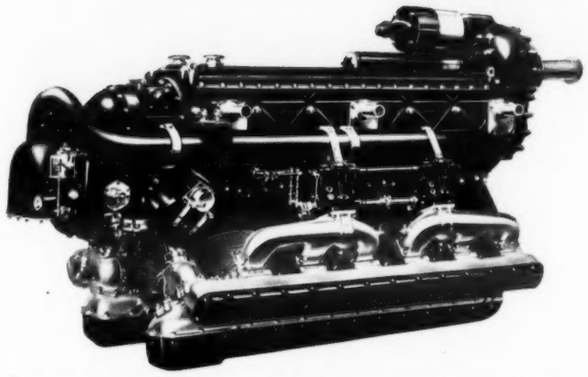
Of the large Italian automobile and engine firms, only ALFA ROMEO, of Milan, continues to be actively engaged in the manufacture of aircraft engines. The proven Alfa 110 and Alfa 115 air-cooled four- and six-cylinder of the pre-war years have again been put into

Alfa Romeo 115-ter six-cylinder engine of 220 h.p. for take-off, driving an Alfa Romeo c.p. airscrew.



A D.H. "Goblin" gas-turbine engine on Fiat's new jet-engine test bench.





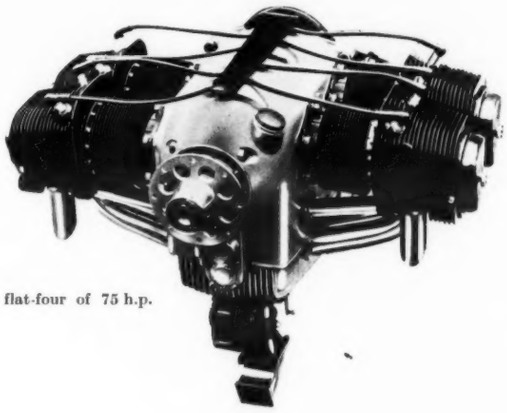
Isotta Fraschini "Delta RC.40" twelve-cylinder engine of 800 h.p. for take-off.

production, though with somewhat improved performance characteristics. They power several Italian aircraft types (Ambrosini S.1001, Agusta P.110 and Ambrosini S.7, Fiat G.46). The *Alfa 110-ter* now delivers 145 h.p. at 2,250 r.p.m. for short periods. In addition, the company has developed an air-cooled 8-cylinder Vee engine, the *Alfa 121,* which produces 365 h.p. for take-off at 3000 r.p.m., as well as a 9-cylinder radial, the *Alfa 131* of 1125 h.p. for take-off at 2,500 r.p.m.

The Lingotto aircraft engine plant of the FIAT GROUP limits its activity to the overhaul of its own as well as of American and British aircraft engines (Fiat A.74, P&W R-1830, R.-R. "Merlin"). In addition, it is preparing the licence production of the D.H. "Ghost" and "Goblin" turbojet engines which will be needed by Italy in the near future if the projected manufacture of the "Vampire" becomes a fact or if Italian designs, such as the Fiat G.80, are ordered. A gas-turbine testing laboratory is already in operation. Recent reports have also suggested that Fiat might be considering the production of Pratt & Whitney engines under licence.

The third big Italian engine works, ISOTTA FRASCHINI, of Milan, is at present passing through a grave financial crisis. Aircraft engine manufacture was abandoned as long ago as 1943. However, a number of the reliable "Delta" air-cooled 12-cylinder Vee engines (RC.35 and RC.40) are still in service and are regularly returned to the factory for overhaul. A development of this engine type (now producing about 800 h.p. for take-off at 2,500 r.p.m.) to 1035 h.p. for take-off at 2,850 r.p.m. and with higher compression (RC.20/55) was planned.

While PIAGGIO, REGGIANE and CNA (Compagnia Nationale Aeronautica) have withdrawn from the manufacture of aircraft engines, though a few Piaggio radial engines and a considerable number of CNA-D.4 60-h.p. horizontally-opposed engines are still in operation, the SAI-AMBROSINI concern has placed two engine models for small aircraft onto the postwar market. The *P.25* flat-twin produces 22 h.p. at 3000 r.p.m., whereas the *P.70* flat-four develops 75 h.p. at 2500 r.p.m.



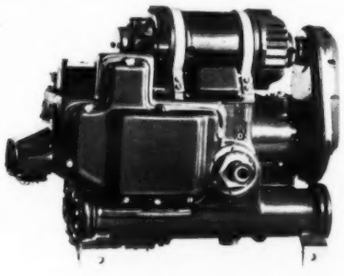
SAI-Ambrosini P.70 flat-four of 75 h.p. for take-off.

THE EQUIPMENT INDUSTRY

Italy's electric, optical and precision mechanical industries are world-renowned and have been partly responsible for the excellent reputation of Italian automobiles and vessels. In the aviation sector four Milan companies are prominent: MAGNETI MARELLI (ignition systems, starters, radio equipment), ERCOLE MARELLI (generators and electric motors), OLEODINAMICA MAGNAGHI (hydraulic systems) and NARDI (landing-gears). Engine accessories are made by ZANZI at Ivrea-Aosta (valves, spark plugs), MONA at Somma Lombardo-Varese (injection pumps) and TAMO-SALVA in Milan (fuel and oil lines). Tires and cables are supplied by PIRELLI, Milan. Aircraft instruments are manufactured by FRATELLI BORLETTI and FILOTECNICA, both in Milan, and by OFFICINE GALILEO, Florence. Similar equipment is produced by MICROTECNICA, of Turin (Siemens automatic pilots and Patin remote compasses), and the old OTTICO MECCANICA ITALIANA, of Rome. The latter has recently developed a novel photographic air survey instrument called "Photozen." AEROSTATICA, of Rome and a Milanese company bearing the tradition-inspired name of LEONARDO DA VINCI are manufacturing the well-known "Salvator" parachutes.

MICROTECNICA magnetic remote compass and secondary compass (Patin licence).

MICROTECNICA gyroscopic compass (Siemens licence) and servo motor.



Controllable pitch airscrews are built to their own designs by FIAT, ALFA ROMEO, PIAGGIO and SIAI-MARCHETTI. Fiat makes two-blade c.p. airscrews for medium engine powers (e.g. Type 5006 for the Fiat G.46 with Alfa 115 engine) and also builds Hamilton Standard c.p. propellers under licence (e.g. Type 5010 for the Fiat G.59 with a R.-R. "Merlin"). Alfa supplies electrically operated two-, three- and four-blade propellers for a power range of 300 to 1500 h.p. and an automatic two-blade screw for 100 to 250 h.p. Piaggio manufactures similar types, whereas the "Idrovaria" two-blade propellers produced by SIAI are suitable only for engines from 100 to 500 h.p.

This summary shows that only a few years after its total collapse, Italy's aircraft industry again occupies an honorable place among the airfaring nation. Touring and training aircraft are again being turned out in series, many of them equipped with Italian engines, propellers and instruments. And even in the domain of jet-propulsion the Italians are making an attempt to catch up the lead of other nations by building foreign aircraft and engines and by gradually developing their own designs.

Sea and Air

Braathens SAFE

A New York report of a few months ago said that American shipping companies were seriously concerned over the effects of the growing competition of the commercial airlines. Two meetings of shipowners dealt with the change-over of Atlantic steamship passengers to the airlines, particularly to lines offering reduced fares. One important factor was that in 1950 a large number of pilgrims travelling to Rome for the Holy Year celebrations had decided to abandon the steamship in favour of the aeroplane.

And in its annual report for 1949, published on May 24th, 1950, the Cunard Steamship Co., Ltd., the biggest Atlantic shipping operator, emphasized the threat to long-term shipbuilding programmes arising out of the Atlantic air services.

Can the shipping lines get out of this dilemma ? It is a well-known principle that if a woman becomes dangerous, you can defend yourself only either by avoiding or by marrying her. Applying this principle to civil aviation, numerous shipping companies are demonstrating a strong inclination to adopt the latter solution. It is no coincidence that the most powerful airline company in the world, Pan American Airways, saw the light of day in 1926 in the offices of the president of a steamship line, W. R. Grace & Co., which operates one of the most lucrative systems of shipping services to Latin America.

That the commercial air carriers not always approve of such consolidation of shipping and airline interests is comprehensible.

*

In Norway the idea of merging shipping and activities seem to be a logical move. The country earns nearly as much revenue from the transportation of goods as from the export of its products. Equally inevitable was the intensive interest which the Braathen shipping concern, a company which was born into the age of aviation, soon began to take in air transportation.

After prolonged activity for Norwegian and foreign shipowners, Ludvig G. Braathen, then a young man, formed his own shipping line in 1926. Business was excellent right from the beginning, and a few years later Braathen owned important financial interests in five shipping companies. Although he lost about 40 percent of his tonnage in World War II, Braathen today again has six sea-going vessels : four tankers and two refrigerated cargo ships. Upon completion of a new tanker of 25,000 tons, scheduled for the near future, Braathen's fleet again will have an aggregate tonnage of 100,000.

Ludvig G. Braathen, the Norwegian shipowner and airline operator.

*

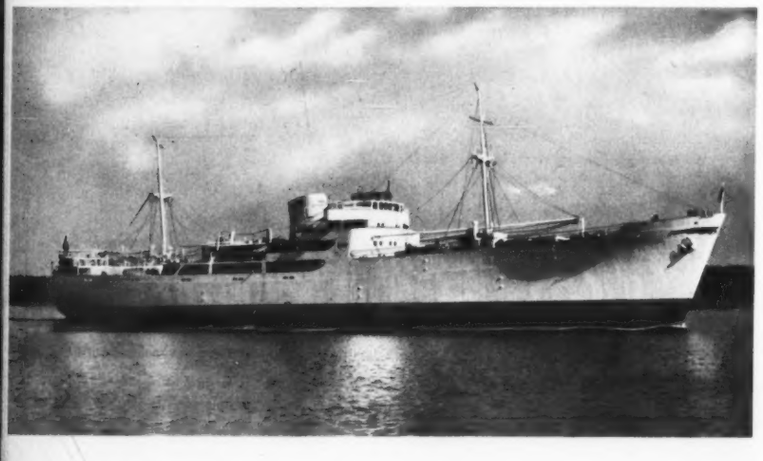
Long ago Ludvig Braathen discovered a burning enthusiasm for aeronautics. As early as 1937, a year before the inauguration of the first scheduled Atlantic air services by Pan American Airways, he applied to the Norwegian government for permission to operate regular Oslo—USA cargo flights. His technical adviser at the time was Bernt Balchen, world-famous Norwegian-American Atlantic and Arctic air pioneer, who has meanwhile returned to the US Air Forces and commands the air-sea rescue formations of the USAF in the Arctic. World War II temporarily put a term of the official negotiations between the Norwegian government and Braathen, but this did not discourage the Norwegian shipping operator from continuing his preparatory work for the formation of an air transport company. Only a few months after the war all plans were ready. In March, 1946, "Braathen's South-American & Far East Air Transport, SAFE" was registered in Oslo.

The consolidation of Braathen's sea and air transport interests had become a fact. Norway already had an airline company, Det Norske Luftfartselskap (DNL), which after the war developed into the country's national flag air carrier. In addition, the great Scandinavian Atlantic air transport consortium, Scandinavian Airlines System, was formed in Oslo in August 1946. Under the flag of SAS, the overseas air services of the Norwegian DNL, the Danish DDL and the Swedish ABA were now being operated by a single air carrier. This event was an indication of future developments. Divergencies and friction between the privately-owned air transport company of the Norwegian shipowner and Norway's national scheduled air carrier and SAS component, DNL, were bound to follow. At the present time each of the two lines is fighting to protect its own interests.

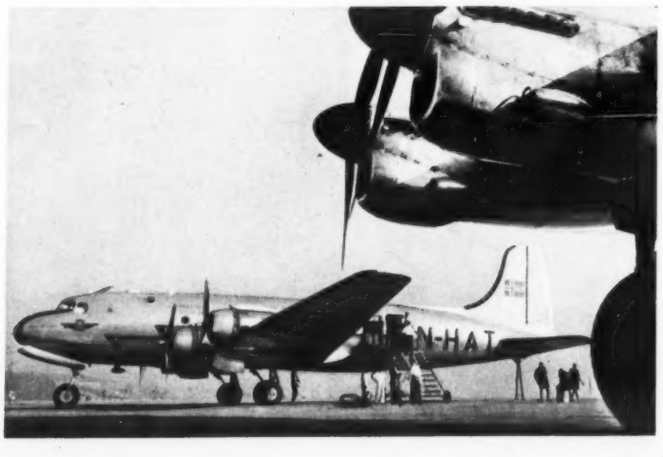
*

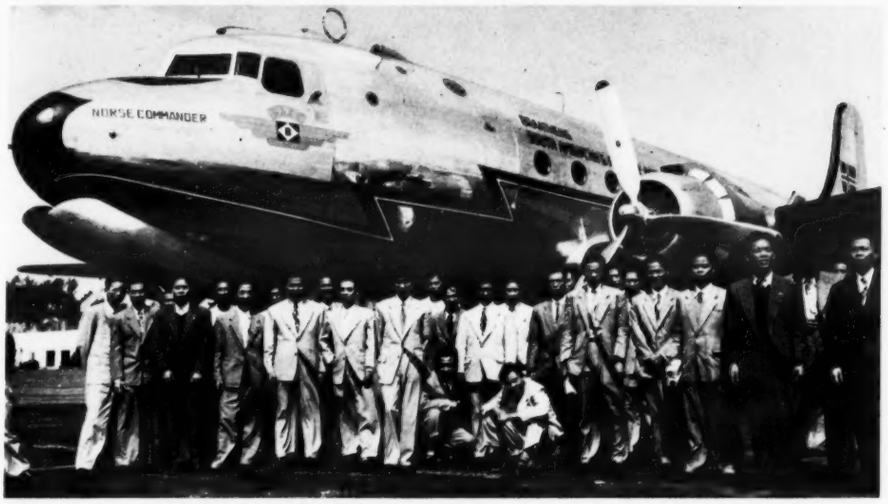
There was little cause for trouble in the immediate post-war years. SAS and Braathen went their own ways. The Scandinavian joint airline flew to the USA, Braathen to the Far East. In February, 1947, SAFE made its initial flight on the Oslo—Amsterdam—Geneva — Rome — Athens — Cairo — Abadban — Karachi — Bombay — Calcutta — Bangkok — Hong Kong route. This service was operated on an irregular basis for two years, but subsequently the Norwegian government

Sea and air : The "Brarena" of Ludvig G. Braathen's Bramora Shipping Company . . .



. . . and a Douglas DC-4 of Braathens SAFE at Dum-Dum Airport, Calcutta.





Chinese seamen use SAFE to fly from Hong Kong to Caracas.

granted Braathens a five-year licence for the scheduled operation of the service.

It is possible that the relationship between Braathen and the Norwegian DNL would have remained friendly if SAS had not inaugurated its own Far East service to Hong Kong in October, 1949. Although DNL refrained from participating in this SAS venture, Braathen regarded the SAS service as an irruption into his own domain. His reaction was violent.

He began by protesting against the fact that the Swedish ABA and the Danish DDL were flying under the SAS insignia, although the Norwegian national airline had no part in the operation. When his protest was ignored, he decided to counter-attack. At the end of March, 1950, he applied to the Norwegian Ministry of Transport for permission to inaugurate a Stavanger—New York service. He based his demand on the claim that the SAS Far East service was depriving him of revenue on his own Hong Kong route which he had operated long before SAS. He was compelled, he asserted, to find new outlets for his aircraft and crews. The inauguration of service to the USA by SAFE was amply justified, he stated, by the mere fact that the Norwegian national airline was treated as the 'Cinderella of SAS' Atlantic operation. In addition, Norway's surface shipping fleet was twice the size of the combined fleets of the remaining two Scandinavian partners. This was just one more reason why greater scope should be given to Norwegian air transportation.

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DNL reacted no less vigorously. It even had a taste of bitterness. This, too, was understandable. SAS no doubt is an enterprise which is managed with great energy and foresight. But from an organizational point of view it nevertheless represents a unique and novel attempt to coordinate and balance differing national interests in a supra-national airline consortium. Inevitably this structure was found to be prone to certain centre of gravity drifts. And DNL, as the financially weakest component of the community, has every reason to prevent violent convulsions within the organization. It therefore opposed Braathen's route application and declared that the application was an ill-concealed attempt to blow SAS apart. It was inaccurate, DNL said, that SAFE had suffered serious damage through the opening of a Far East service by SAS. SAFE has been incurring considerable losses on its Far East services anyway, long before the SAS route was inaugurated, but these losses had been made good with profits taken from Braathen's shipping operations.

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At the end of April, 1950, the Norwegian government rejected SAFE's application with the explanation that DNL had been flying the Norway—USA route for years—statistical proof was available to show that DNL's operation within the framework of SAS was more than adequate to satisfy Norwegian traffic needs.

This decision of the Norwegian air transport authorities may settle the problem of Norwegian air route allocations for the time being.

A Douglas DC-4 of SAFE landing at Karachi Airport.

The first entirely welded tanker in the world : the "Braconda," of 16,050 tons, of Ludvig G. Braathen's Braconda Shipping Company.

A final solution to the conflict of interests between scheduled and irregular air operations, shipping and airlines has not been found, however. These problems surpass the limit of individual national organizational possibilities. The Fourth Annual General Assembly of the International Civil Aviation Organization at Montreal has directed the ICAO Council to create a clear definition of the term "scheduled international air service." Once this has been accomplished, the international organizations such as ICAO, IATA, FITAP, shipping conferences and economic committees of the United Nations will find themselves saddled with the thorny task of bringing the conflicting requirements of the various modes of transport and categories of transportation of all participating nations on to a common denominator.

Our article series on "Wings Over No-man's Land" *in issue No. 3, 1950, of INTERAVIA REVIEW has produced a variety or reactions. That Germans expressed approval of certain opinions coinciding with their own interests was to be expected. The fact, however, that approval came even from circles of the war-time Allies shows that the world is attaching importance to the re-establishment of a normal situation.*

In the mail we found a letter from the Eastern Zone of Germany. It will be of interest also to people outside of purely German aviation circles. Do not mind the somewhat sensational title :

By the Grace of Stalin?

In the East German Zone of occupation—which beyond the Iron Curtain is described as the German Democratic Republic—banners and posters are the main element of decoration. There is also a very small poster advertising gliding and sailplane flying. It practically disappears amongst the thousand slogans of the Eastern vocabulary, but former pilots gloat over it with ill-concealed satisfaction.

In effect, something like glider flying is again going on in the Eastern Zone. It is true, of course, that the news being circulated about this revival of German sporting flying should not be taken too literally. Altogether, Eastern Germany's gliding activities seem to be confined to about a dozen unpowered aircraft, mostly training gliders which survived the end of the war in a disreputable state and have since been repaired. These aircraft are flown occasionally, but mostly they are used for propaganda purposes, and crack-ups are more frequent than successful flights. For the time being the Germans are reduced to painful improvisation, which is understandable. Where in Germany's Poverty Zone should young people obtain the materials and tools necessary for the construction and repair of gliders or sailplanes ? The good advice which a number of experts in Western Germany offer their brothers behind the Iron Curtain is not sufficient to modify this grotesque lack of the most elementary things. But efforts are now being made in the East to remedy the situation. It is more than likely that the manufacture of gliders will shortly be started on a production-line basis, and as the plant chosen for this task the former aircraft works of the Gothaer Waggonfabrik has been mentioned.

Sailplane flying will certainly receive considerable impetus in the Eastern Zone in the not too distant future. Whether it will reach the proportions of some years ago seems questionable for the time being, but there is no doubt that it will be developed by methods resembling those in use at the time when the slogan about "A People of Airmen" was current.

*

Plans for an Eastern Zone Air Transport System

Needless to say, the East German Government's recent request to the Soviet occupation authorities for permission to operate an air transport system will be granted. It is one of the rules of the Popular Democratic game to submit a request in Moscow only after its approval is assured. People in the know have gone so far as to assert that the foundation of an Eastern German air transport system will be laid with ten Douglas DC-3 aircraft built in Russia under licence. The routes to be operated are "naturals" : to Moscow, to Warsaw, to Prague, to Budapest, to Bucharest and to Sofia. No service to the west of Europe seems to be contemplated for the time being.

There are today's development trends. They are not always clearly discernible in the confusing atmosphere of the Cold War and its attendant exaggerations and half-truths. It is easy to denounce this miserable glider flying activity and the projected modest civil air services in the Eastern Zone as a device to provide camouflage military training to East German youth or as a cloak for the resurrection of a German Luftwaffe. Such denounciations have been made. But the critics disregard the core of the problem, even those who claim that its significance is in the fact that aeronautical activity of any kind in Germany infringes the Four-Power Control Council regulations issued at the end of the war.

Let us not delude ourselves : the Soviet Union does not need to strengthen her own military potential by encouraging glider flying activities within Communist youth organizations or by permitting a handful of civil transport aircraft to operate in a country belonging to her sphere of influence. Her own air strength arm is great enough to be able to dispense with trifles. And should the Soviet Union wish to establish a German air police or even a full-blown East German air force—indications that she has such plans are available—she would not bother to supply a pretext to hide her activities behind a bogus civil air transport system.

It would be interesting to know why the Soviets seem to approve the resurrection of a German civil air transport system. Probably it would be more pertinent to ask why they should *disapprove*. The Soviet attitude is no doubt based on the consideration that small-scale gliding and air transportation are quite harmless, the Eastern Zone depends upon Moscow in all matters, whether it likes it or not. Quite apart from that, the right to engage in aeronautical activities is one of the normal prerogatives of any sovereign state. Hence, it may seem wise to permit such activities at a time when political developments have long since invalidated earlier flying bans.

Gliding and air transportation in the Eastern Zone of Germany thus form a cunningly laid-out bait for Germans in the Western Zones. Not in the sense that former airmen in their thousands will try to cross over to the Eastern side. The East's alien political system and the disastrous standard of living behind the Iron Curtain certainly offer no attraction. But you can bet a peanut to a dollar that invitations to glider pilots in the Western zones will soon be extended from behind the Iron Curtain and that some individuals will accept these invitations with alacrity—provided, of course, that the whole thing can be kept dark. An interesting by-product will be that the Western European High Commissioners will then have to find an answer to the sixty-four-dollar-question whether or not a citizen of the West German Federal Republic convicted of engaging in some form of aeronautical activity in the German People's Republic will be punishable under the Control Council laws . . .

Much more serious are the psychological repercussions which the revival of civil aviation in Eastern Germany is bound to have on the West German public. It is no secret that the Western Allies' categorical rejection of even the most modest German aspirations in the field of aeronautics is regarded with growing bewilderment not only by former members of the defunct German *Luftwaffe*, commercial and sporting aviation but also by the vast masses of the public. Four years ago the prohibition of every form of aviation was accepted without murmur because people were too preoccupied with their most pressing, elementary material needs. On the contrary, the inauguration of foreign air services to and across Germany was welcomed as a sign that Germany was being re-incorporated in the global airline system. The atmosphere has changed, and even the man in the street will readily quote a series of seemingly valid reasons at you to explain why civil aviation should again be authorized in Germany :

"It is stupid to state that gliding and air transport might form a menace to the security of Germany's neighbors. The military usefulness of civil aircraft would not be greater than that of a bicycle or a motor truck."

"The Allies are maintaining their ban on German air transport simply because the West's airlines are afraid of German competition. The foreign airline companies are the real obstacles to a rapid solution of the German civil aviation problem."

"If it had its own air transport system, the Federal Republic would save dollars which it could use for constructive purposes. The services operated by foreign companies are an invisible dollar export."

"The rights of a sovereign state included the right to govern its own air space, and without these rights any German government will remain a mere puppet. Nothing could prevent the elaboration of a kind of Schuman Plan of the air."

These arguments, which one encounters everywhere in Germany today are easily refuted. In part they deal with the problem from a distorted angle, and partly they ignore the progressive political development of Western Germany. Nevertheless, they are recorded here because they form the basis of certain opinions which one day may assume importance on a higher political level.

It might be useful to recall recent arguments on the question whether or not Germany should make an active contribution to the Atlantic Pact. Some people went as far as suggesting German infantry divisions, but on the whole these nebulous projects met little enthusiasm even in Germany. The few incurable soldiers of fortune and mercenaries still alive in Germany would not sell their hides so cheaply. If a German contribution to the defensive system now being built up under the Atlantic Pact ever did become the subject of serious discussion—and nobody in Germany would be anxious to make such a contribution—this problem could certainly not be broached without first abolishing the ban on Germany's activities in the field of aeronautics. Otherwise those who today are impatiently waiting for the re-establishment of glider flying and air transportation might easily come to the conclusion expressed in a careless phrase of some time ago : "WHY NOT LET THEM FIGHT FOR THEIR CONTINENT THEMSELVES !"

Sometimes it looks as if the West had already lost an advance small skirmish in the Cold War as a result of its hesitant attitude towards the Western German aviation problem. The Soviets have found that by permitting the Germans to rebuild their aviation and by helping them to re-establish various forms of aeronautical activity they have gained a distinct asset of which they will make full use when the time is ripe. The cry for the restitution of certain sovereign rights do not halt at zonal frontiers—and it obviously disregards the fact that such rights granted to the Eastern Zone in reality are purely illusory.

The perspective is curious indeed : German Aeronautics . . . by the Grace of Stalin.

"Half-Century Air Show"

Brussels

10TH TO 25TH JUNE, 1950

A general view of the Brussels air show. The historica section is at the extreme left. In the centre foreground the Fiat G.46 fighter-trainer, right foreground the Dassault MD.315, behind it a Gloster "Meteor."

What, you may exclaim, another air show ? Aircraft exhibitions, so fashionable before the war, seem to have lost much of their interest in recent years . . .

This is less than true so far as the aircraft show which took place in Brussels from June 10th to 25th was concerned. It had a special attraction : not only did it mark the middle of the Twentieth Century, but it also commemorated the first half-century of rapid aeronautical progress. The organizers of the Brussels show were fully conscious of the historic significance of nearly fifty years of powered heavier-than-air flight and arranged their exhibition accordingly. In one section they included equipment in use today ; in another they recapitulated the progress achieved in the field of aeronautical engineering since the beginning of the Twentieth Century ; finally, they organized their flying display—an inevitable adjunct to any aircraft show—in such a way as to provide a foretaste of what is in store for the world tomorrow.

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The "museum" section of the show was assembled under the able guidance of the Belgian National Aeronautics Committee and its Chairman, Air Force Colonel Baron Woelmont ; much of the executive work was carried out by the Committee's Secretary Monsieur Calpaert. This part of the show would not have been practicable without the enthusiastic collaboration of Belgium's neighbor, France, which supplied some of the most priceless items from the Paris Aeronautical Museum. Monsieur Charles Dollfus, the museum's amiable curator, supervised the selection.

The historical exhibits included Chanute's glider, which had inspired the first aircraft of the Wright brothers ; a 1910 Nieuport aeroplane, a two-seater Blériot XL-B of World War I ; a twin-engined Caudron G4 observation and attack aircraft ; Juan de la Cierva's Autogiro which flew from London to Paris in 1928 ; the famous Bréguet "Question Mark" which crossed the Atlantic from Paris to New York in 1930 ; the Potez 53 which won the Deutsch de la Meurthe Cup in 1933 ; a Hawker "Hurricane" single-seater fighter which fought in the Battle of Britain ; and a series of replicas of pre-1914 aircraft.

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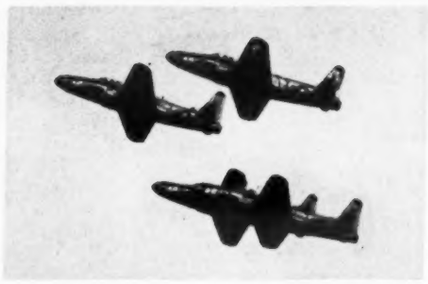
The present state of aeronautics was illustrated by a series of tried-and-proven aircraft in current use. *Belgium,* the hostess nation, exhibited a Gloster "Meteor 4" twin-engined fighter which equip some of her Air Force squadrons, together with a Rolls-Royce "Derwent" turbojet engine built under licence by F.N., the Belgian national arms concern ; at the other end of the military aircraft scale there was the veteran Stampe & Vertongen SV 4B elementary trainer, which is still doing yeoman service with several air forces and even flying clubs, was on show. Belgium's participation was rounded off by the Fairey "Tipsy Junior," "Belfair" and "Tipsy 52" sporting aircraft.

Distinguished visitors : The Belgian Defence Minister, Monsieur Moreau de Melen, listens to Monsieur Charles Dollfus, Curator of the Paris Air Museum. At right Cierva's 1928 Autogiro. It was M. Dollfus' enthusiastic collaboration which made possible the historical section of the show.

France displayed her Dassault MD 315 twin-engine light military transport and the SIPA 901 personal aeroplane ; ultra-lightplane enthusiasts had an opportunity of admiring the Fouga "Sylphe" jet-powered glider which has created a sensation wherever it has put in an appearance on both sides of the Atlantic. In the field of aircraft engines, France's Turboméca company exhibited the "Piméné," "Oredon" and "Artouste" turbojets. *Italy's* reviving aircraft industry was represented by the Fiat G. 46 trainer and the Macchi MB. 308 two-seater light tourer. Models showed the Breda-Pittoni 471 twin-engined passenger and cargo liner and the four-engined Piaggio P.140 cargo transport project, the latter a proposed development of the wartime P. 108 heavy bomber.

Retrospective : Chanute's glider in the foreground. Romantic stringbags.

The P.1081 in flight.



The "collective" sensation of the Antwerp Air Display : The USAF's "Skyblazers," four Lockheed F-80 "Shooting Stars" in flight formation.

It looks like an omelet, behaves like a high-speed fighter, and is a jet-propelled bomber : the English Electric "Canberra" going through its paces at Antwerp.

Great Britain showed the versatile Short "Sealand" amphibian, as well as models of some new aircraft, including one of the Vickers Supermarine "Attacker Trainers. "The latter is a two-seater project and attracted considerable attention. It was disclosed that the aircraft is to be powered with a Rolls-Royce "Nene" turbojet, but no other details were released. The *Dutch* showed their Fokker S.11 trainer.

The Lockheed F-80 "Shooting Star" was the major exhibit representing the *American* aircraft industry. In the four-seater personal aircraft field the Americans exhibited the Beechcraft "Bonanza." A Sikorsky S.51 four-seater helicopter emphasized the future role of the rotary wing aircraft. Busily it carried out demonstration flights throughout the duration of the show.

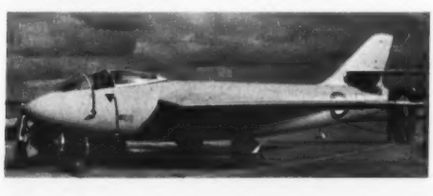
The Iron Curtain also turned up at this mid-century exhibition. *Czechoslovakia,* the only satellite country with an aircraft industry worth mentioning, sent its Aero 45 twin-engined feeder transport and its Sokol M1D and its Zlin 22 sports machines.

Piaggio P.140 cargo transport project, a development of the wartime P.108 four-engined bomber.

Breda-Pittoni 471 twin-engine passenger transport project.

Model of the Vickers-Supermarine "Attacker Trainer" (R.-R. "Nene" jet).

The individual "clou" of the show : Hawker's famous Chief Test Pilot, Squadron Leader T.S. ("Wimpey") Wade, demonstrated the new P.1081 fighter. He flew London-Brussels in 21 minutes, back in 22.



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The flying display at Deurne Airport, Antwerp, was inaugurated on June 25th by Monsieur Craeybeck, Mayor of Antwerp, who appropriately arrived by helicopter. Six countries, the USA, France, Britain, Holland, Italy and Belgium, together gave a demonstration of a kind of flying which even today is still sometimes considered as sensational but, from a technical point of view, will be commonplace tomorrow. While it was a pity that the weather was not as good as it might have been, it brought out the best qualities of the pilots and their equipment.

The whole of Antwerp seemed to be assembled at the field. On the eve of the display the participating aircraft were lined up on the field, nearly fifty of them and mostly jet propelled, and they were reverently inspected by the population.

The individual star turn of the display was the demonstration of the new Hawker P.1081 single-seater fighter by Squadron Leader T. S. Wade, the manufacturers' Chief Test Pilot. The fantastic speed and manoeuvrability of this swept-wing aircraft, which the day before had flown from London to Brussels in 21 minutes and then returned to the British capital in one minute more, made a breath-taking impression and was duly applauded by the Belgian public.

An equally brilliant performance, of a different nature, was put up by an acrobatic team of the US Air Force, the "Skyblazers," a group of four Lockheed F-80 "Shooting Star" fighters under the command of Captain Gordon. Their tight formation acrobatics beat anything that had previously been seen in Belgium.

These two main events were surrounded by demonstrations of a variety of aircraft, such as the English Electric "Canberra" twin-engine light bomber which gave its usual fighter-like performance. A group of RAF "Vampires" went through their aerobatic paces. The French showed the SO 6000 "Triton" twin-jet experimental aircraft and the Fouga "Sylphe" powered glider. Another jet was the British Gloster "Meteor 8," which was followed by a formation of Belgian Air Force "Meteor 4s." Piston-engined aircraft types included the Dassault MD 315 light transport, the SO 30P "Bretagne" thirty-passenger airliner and the Bréguet "Mercure" cargo transport, the Italian Macchi 320 six-seater, the French Minicab and SIPA 902 lightplanes, and many more. The Americans again were represented by Beechcraft, this time with the "Mentor" trainer.

One of the most unforgetable impressions was created by the Dutchman Sonderman, Fokker's chief test pilot and simultaneously Prince Bernhard's private pilot, who astounded the assembled crowds by his audacious demonstration of the S.11 "Instructor" trainer aircraft, the wing tips of which seemed to scrape along the ground and zig-zag in and out between the aircraft parked on the field. Unbelievable, and a little frightening.

The good people from Antwerp and surrounding Belgian localities went home happy. They had seen the fastest air display ever given in Belgium, watched jets streaking through the sky and had been frightened exactly in the right degree. Many among them probably will regret that they won't be around, fifty years hence, to attend the full-century and millenial air display, which no doubt will be held at Antwerp-Deurne in the year 2000 A.D., to witness the achievements of aeronautical progress in the second half-century of aviation.

German Radiolocation in Retrospect

By *Ministerialdirektor Dipl.-Ing.* L. BRANDT, Düsseldorf.

Besides his activity as chief of research for Telefunken G.m.b.H., the author from 1942 exercised the functions of Chief of the Radiolocation Development Group under the General Commissioner for Communications and after 1943 became head of the "Rotterdam" (H2S) Working Group. In the following pages he sums up the development of radar in Germany.

Radar today has become an indispensable element not only of aeronautics but of modern civilisation as a whole. Safety at sea and in the air largely depends upon this new branch of electrical engineering which in Germany was called "*Funkmesstechnik*" (radio measuring technique) and in the Anglo-Saxon countries Radiolocation and later RADAR. Even inland communications, such as railways, road vehicles or river and canal shipping, will be unable to dispense with this traffic aid in the long run. For radiolocation not only widens the possibilities of recognition and offers maximum accuracy of location and panoramic view. It also operates infallibly at night and in fog, and it even offers the possibility of determining the contours of an object.

The new technique of radiolocation, which was initiated only a few years before World War II, was developed for a multitude of purposes in both camps during the late war and was used operationally on a tremendous scale. During the war a number of major steps along the road of technical progress were first made in Britain and America. But it should nevertheless be interesting to examine also the evolution in Germany and to study some of the reasons for the recurring slow-downs in development in that country.

Development until 1940

The fact that the German engineer *Hülsmeyer* had taken out a patent in Germany and in Britain as long ago as 1904 for an instrument capable of receiving electromagnetic waves reflected from a surface vessel seemed to have been completely forgotten in both countries. When perusing these patent applications today, it appears entirely incomprehensible that this new idea should never have been followed up throughout three full decades (Fig. 1). It was only in the 'thirties that interest in this field gradually was aroused. In this connection, the French ocean liner "Normandie" carried out experiments to protect herself against collisions with icebergs. In November 1934, the head of the Radio Department of Britain's National Physical Laboratory, Robert A. Watson-Watt, began the evaluation of the principle of radio direction finding.

In Germany, too, there followed a step which until far into World War II had an important bearing on the trend of radiolocation in that country: the German *Naval High Command*, by seconding an Engineering Officer to the greatest German wireless manufacturing company, sought to establish a joint radiolocation research programme with the firm. Astonishingly enough, no agreement was reached, and the German Navy thereupon decided to charge a newly-formed concern, GEMA, with the development and manufacture of the required equipment. Whatever may have been the reason for this decision—erroneous estimation of possibilities by the company concerned or theoretically better security protection—it resulted in the non-utilisation of the expert knowledge and the thirty-year tradition of the radio industry, and the new company had to start from scratch in every respect, from physics to design know-how, from valve development to quantity production. Any engineer will realise that such an experiment necessarily encountered the greatest difficulties and was incapable of achieving the same success as would have been possible by close cooperation on a broad basis. The German Navy grasped this fact only very much later.

GEMA developed two types of equipment: an *Air Space Surveillance Unit* called "*Freya*" (Fig. 2)—operating on a wavelength of 2.40 metres—which as early as in June 1938 had a range of 75 miles when used against aircraft (Junkers Ju 52); and a *Surface Vessel Detection Unit*, which originally operated on a wavelength of 50 cm and later was switched to 80 cm. For the detection of surface vessels another type of equipment, working on a wavelength of 14 cm, was also studied in 1935. But it had a range of only two miles. Reflections from the water surface and the general instability of the transmitters and receivers available

KAISERLICHES PATENTAMT.

PATENTSCHRIFT

— № 165546 —

KLASSE 74 *d*.

CHR. HÜLSMEYER IN DÜSSELDORF.

Verfahren, um entfernte metallische Gegenstände mittels elektrischer Wellen einem Beobachter zu melden.

Patentiert im Deutschen Reiche vom 30. April 1904 ab.

Fig. 1.

Fig. 1: Christian Hülsmeyer, of Düsseldorf, on April 30th, 1904, was awarded German patent No. 165,546 and on June 4th, 1904, British patent No. 25,608 to protect "a method of detecting and recording distant metallic objects (ships, railway trains, etc.) by means of electromagnetic rays". Figure 1 of the patent application illustrates "a steamship carrying this equipment, sighting an unidentified vessel by wireless".

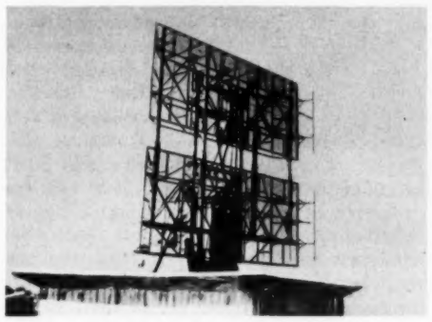


Fig. 2: Antenna arrays of the pre-war "Freya" air space surveillance unit which had a range of 93 miles. Transmission and reception antennae (operating on 2.40 metres) are separate.

at the time where held responsible for this. The tests on shorter waves were therefore discontinued. Until the fatal year of 1943, the idea was prevalent that wavelengths of between 10 and 20 cm were unsuitable for radiolocation purposes. As is to be demonstrated later in this article, this was an extremely critical fallacy, especially as regards its effect on the war at sea. It was a contributing factor to the loss of a large number of German sea-going submarines.

So far as the *Luftwaffe* was concerned, the *Anti-Aircraft Artillery* at an early stage had placed a contract with C. Lorenz A. G., through the intermediary of the then competent Army Weapons Division *(Heereswaffenamt)*, for the development of an anti-aircraft gun-sight. For the anti-aircraft warning service it was planned to make use of the developments achieved by the Navy. The first 2.40-metre wavelength "Freya" Air Space Surveillance Unit of the Navy was demonstrated to the Luftwaffe at the turn of 1936-37 at Pelzerhaken, in the Bight of Lübeck. The Luftwaffe then ordered 12 units of this type and worked out tactical and technical specifications for numerous projected uses.

In 1937, when the responsibility for air space surveillance was shifted from the Anti-Aircraft Artillery to the Chief of the Communications Services, the Telefunken company was awarded a contract by the German Air Ministry to the specifications worked out jointly by the "*Luftwaffenführungsstab*", the Inspectorate of the Anti-Aircraft Artillery, the Staff of the Communications Services and the Technical Department *(C-Amt)* and calling for the development of an *Air Surveillance Detection Unit* (providing for distance, azimuth and elevation measuring at a range of 25 to 35 km), and of a *radio gun-sight*. The order already contained the requirement that the radio

gun-sight should incorporate provision for switching over to SHF-waves for the purpose of obtaining the desired aiming accuracy.

Telefunken G.m.b.H. went about its task in the most efficient manner and immediately evolved the correct principle of procedure. It selected the shortest wavelength practicable at the stage of development which had then been attained, namely, 50 cm. Since 1934, Telefunken had been working on a series of research projects in the SHF field and had established the basis for a multitude of practical applications, e.g., for wireless line-communication on UHF (to replace cable communications) and for anti-collision protection of aircraft. The result was that the 50-cm wavelength was the logical choice for the new radiolocation project. A concave reflector measuring 10 ft. in diameter was sufficient to obtain the necessary beam effect and could easily be installed at every anti-aircraft gun post. The common antenna for transmitting and receiving was recognised as a prerequisite for the concave reflector. The most important innovation was the beam formation, and thus the automatic direction finding by means of a defocussized rotating antenna.

Curiously enough, and probably because of the parallel development which had been in progress at the works of C. Lorenz A. G. for a considerable period of time, the Anti-Aircraft Artillery did not press the manufacturers for the completion of the instrument. It was only in July 1939 that the problem assumed an entirely new aspect. The Wireless Section of the German Air Ministry's Technical Department, which was completely separated from the technical staff of the Anti-Aircraft Artillery, suddenly put forward the old requirement of the "*Luftwaffenführungsstab*" for a short-range air surveillance unit without special anti-aircraft artillery devices, particularly without radio beam direction finding. A laboratory type was demonstrated to Hitler and Gœring at the Luftwaffe experimental station at Rechlin in July, 1939. It was characteristic of the internal divergences prevalent at the German Air Ministry that the official responsible for the anti-aircraft warning service was not invited to the demonstration. A few weeks after the outbreak of war, the manufacturers were ordered to simplify

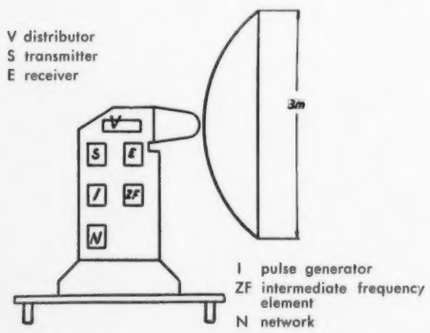


Fig. 3 : Diagram of the "Würzburg A" 50-cm wave short-range surveillance set for maximum intensity D/F and one-man operation. This unit, which was first demonstrated in July 1939, was later converted into the "Würzburg C" A. A. radio gun sight. (Fig. 6.)

this experimental surveillance unit, which meanwhile had been given the name "*Würzburg*", so that it could be operated by one man; simultaneously a mass production contract was placed (Fig. 3). At the same time 200 "Freya" air surveillance units were ordered for the anti-aircraft warning system.

When the air war proper started in conjunction with the German offensive against the West, the first "Würzburg" was suddenly removed from experimental use and placed into active operation as an anti-aircraft gun-sight at Essen-Frintrop. Hence it was not used for surveillance purposes but immediately did service as a part of the active anti-aircraft defences. Although it lacked the instruments essential for an anti-aircraft gun-sight, it immediately disclosed the great value of its operating principle. Initially, the radio beam unit was replaced with a simple maximum intensity D/F, which was manually operated. A crew of three, for elevation, azimuth, and distance, communicated their values to the anti-aircraft battery by microphone. The result was that this most efficient anti-aircraft emplacement was specially mentioned on the British wireless. Hence the instrument, which originally had been developed for short-

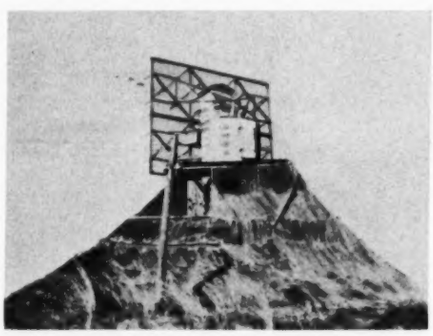


Fig. 4 : In 1939 the first "Freya" unit was placed into operation on Wangeroog Island, in the North Sea. It was used to guide a German fighter formation in an air battle off the North Sea coast on December 20th, 1939. The mounting tower is camouflaged.

range air surveillance, and especially for elevation measuring, became an anti-aircraft gun-sight as soon as it went into operational use.

On the other hand, a special radiolocation research and test station had been established on Wangeroog Island to develop devices for the protection of the German Bight. This station conducted exhaustive tests of the "Freya" instrument and also began to develop units which could be dismantled for transportation by air. In addition it elaborated air interception guidance systems for day and night operation. The first model of this experimental series (Fig. 4) picked up the British formations entering the German Bight on December 20th, 1939, at a distance of 70 miles. On the basis of the readings on the cathode-ray oscilloscope, a formation of fighters was guided to the attacking aircraft, and severe losses were inflicted on the British bombers near Borkum as they were leaving the area.

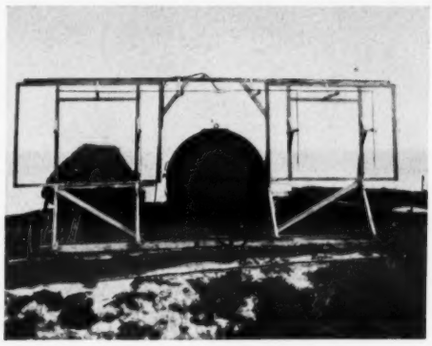


Fig. 5 : Searchlights with "Parasit" equipment could be rotated directly into the direction of the "Freya" radiolocation waves reflected by enemy aircraft.

This was the origin of the so-called AN-Technique which later on produced a high degree of accuracy. Wangeroog also perfected methods for the fire control of multi-gun batteries and for searchlight directing, which on the basis of a central transmitter ("Freya") utilised reflection by the target (*"parasite method"*) and therefore required only receivers at the command unit of the anti-aircraft battery or the searchlight emplacement (Fig. 5).

Very early on the necessity of developing an aircraft identification unit became evident. To collaborate with the "Freya" long-range unit (on 2.40 metres) a pulse identification unit allowing for distance measuring (*"Erstling"*) was completed by GEMA in 1938. In December of the following year a contract for 3,000 such devices was placed. A model for the "Würzburg" short-range (on 50 cm) equipment had been developed by Air Force Engineer Dr. Plendl according to the same technique. For obscure reasons, however, another identification unit, the "*Zwilling*", was finally adopted by the Technical Department, with utter disregard to the experience gained at the Wangeroog experimental station and that of Dr. Plendl. Probably this was due to the fact that the importance of distance measuring was not then fully realised and that an instrument of maximum simplicity was needed. The selected device offered no determination of distance but, after the reception of the 50-cm wave of the radiolocation set, merely released an audio-modulated UHF signal which could be traced on the "Würzburg" by means of supplementary antennae. Large quantities of this instrument were ordered and later found to be completely useless.

The entire problem of identification equipment was never quite straightened out throughout the duration of the war. Since the large-scale utilisation of "Freya" coincided with the dispersal of all radiolocation waves, which had been made essential by the enemy's interference, only an improvised solution could be adopted by separating the "Freya" identification frequency from the radiolocation frequency proper.

Hence it appears that at the beginning of the air war Germany possessed mobile radiolocation sets operating on wavelengths

of 2.40 metres, 80 cm and 50 cm. The first were well-suited for long-range air surveillance, the 50-cm unit was useful for short-range air surveillance and simultaneously was adaptable for use as a radio gun-sight. At about the same time, Britain had installed fixed RADAR stations, operating on a wavelength of about 12 m, along her South and East coasts. The British stations made it possible to identify approaching formations at considerable distances, but at the same time they presented the danger of being " underflown " by the enemy because the long waves quickly detached themselves from the surface of the sea. At an early stage it was realised in England that the relatively low-frequency " limelight " had to be supplemented by a high-frequency " searchlight ", and in 1939 laboratory research teams were instructed to develop a useful solution providing for adequate transmission power and receiver sensitivity on waves of about 10 cm length.

The Effect of the Initial Stages of the Air War

After 1940 the anti-aircraft artillery soon received an equipment with a range of 30 km, a measuring accuracy of ± 100 m and a D/F accuracy of ± 1/2 degree (Fig. 7) in the form of the " Würzburg " instrument additionally equipped with radio beam D/F. In the " Freya " the aircraft warning service had an air surveillance instrument with a range of 93 miles. As the latter was not capable of determining elevation it was supplemented by the " *Fahrstuhl* " (elevator) equipment early in 1940. " Fahrstuhl " worked on the same basis as " Freya, " and made possible the determination of the enemy's height. It was sufficient for day-fighting purposes within the range of the " Freya. " Furthermore, the " Freya " equipment was successfully used for " dark " night-fighting (without searchlights) already in the summer of 1940, in conjunction with a guidance system (AN-system) developed by *H. Diehl*, head of the Wangeroog experimental group.

Guidance of the fighters was facilitated by the use of the " Würzburg " for the determination of enemy elevation, especially when the unit was given a range of 45 miles by the use of a 23 ft. reflector (" Würzburg Giant ", Fig. 8). Initially, this was sufficient for fighter operations. The first night-fighter success, in conjunction with searchlights, was scored in the middle of 1940 with the aid of an ordinary " Würzburg ". Subsequently about 1500 " Würzburg Giants " were built and erected in all parts of the war area. In addition, " Würzburg Giants " and " Freya " units were installed on rail chassis and organised into special night-fighter guidance command groups. Used as mobile units, they were very successful, especially on the Eastern front. Thus, the requirements of fighter guidance seemed to be solved with " Freya " and " Würzburg Giants ".

Notwithstanding the successes obtained with the normal " Würzburg " (equipped with a 10-ft. mirror), of which 4,000 units were ultimately built, the Anti-Aircraft Artillery continued to demand a special *Flak* radiolocation set to its original specifications. It was given the name " *Mannheim* " and distinghuished itself by certain refinements in operation, such as D/F and distance measuring by instruments in place of cathode ray oscilloscopes, communication of the measured values by electric transmissions (which were soon fitted also to the " Würzburg "). On the other hand, this equipment needed about 150 tubes, compared with the 50 valves of the " Würzburg ", and the extensive absorption of development capacity did not result in any decisive advance in the overall picture of radiolocation.

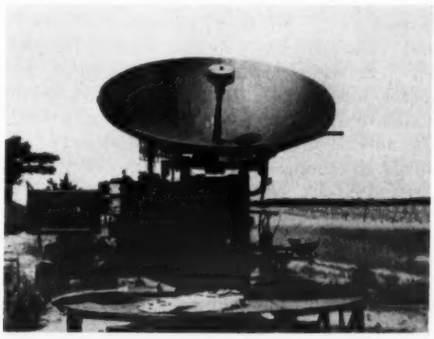


Fig. 6 : The mobile A. A. radio gun sight " Würzburg C " operating on a 50-cm wave had rotating antennae to produce a narron radio beam and was operated by three men ; 4,000 sets were built.

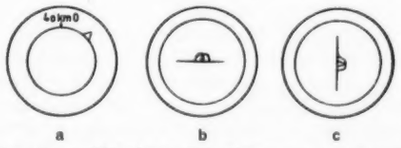


Fig. 7 : " Würzburg C " diagram : an overall scope (a) simultaneously indicates the distance of the target (up to 25 miles) ; azimuth and elevation of the target are seen from the direction of the two other scopes (b and c). Equal height of pips indicates accurate focussing of the target.

Fig. 8 : The " Würzburg Giant ", a high precision radiolocation unit operating on 50 cm at ranges up to 45 miles, served for fighter guidance but was also used on anti-aircraft gun towers. 1,500 sets were built and on the whole established at permanent posts ; a few special sets were made mobile by mounting them on railway chassis.

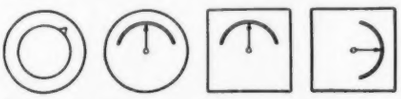


Fig. 9 : Instruments of the " Mannheim " anti-aircraft gun sight. Left to right : *overall scope (as on " Würzburg ") and indicators for distance, azimuth and elevation. Readings were automatically transmitted to the A. A. battery.*

Fig. 10 : " Wassermann " long-range warning station (wavelength 2.40 metres) for ranges up to 200 miles comprised antenna arrays of the " Freya " unit. About 150 sets were installed.

Along the coasts fixed stations with ranges of 185 miles (" *Elefant* " on 7.5 metres and " *Mammut* " on 2.40 metres) were used initially. To these were subsequently added rotating small and large " *Wassermann* " stations on 2.40 metres (about 150 stations), most of which were fitted with additional equipment for " AN " and altitude determination (Fig. 10).

In night-fighting it was soon realised that airborne radiolocation equipment was essential. Once the night-fighters had been guided to the attacking enemy aircraft with the help of " Freya " and " Würzburg Giant " equipment on the ground, the maintenance of contact with the enemy was by no means assured. An airborne set, therefore, was an indispensable supplement. Experimental flights with an ultra-red instrument (" *Spanner* ") did not produce any practical results. Later on, an experimental laboratory device called " *Lichtenstein BC* " was introduced which had a range of 2.5 miles and provided useful D/F in azimuth and elevation by the use of a rotating phase switch which actuated the different antennae in rapid succession. This set, which was satisfactory only under certain conditions but which nevertheless resulted in numerous additional enemy aircraft being shot down, was completed by " *Lichtenstein SN 2* " on a wavelength of 2 metres. After it had been possible to cut the location of targets within the close range of the " Lichtenstein SN 2 " from 2600 feet to 650 feet, the original BC instrument was dispensed with. From then on, a night-fighting instrument fully meeting all the requirements of the time was available. It resulted in the night-fighter being less dependent on ground guidance and greatly contributed to the effectiveness of the night-fighter squadrons.

The other concerns of the German radio industry ultimately also conducted intensive

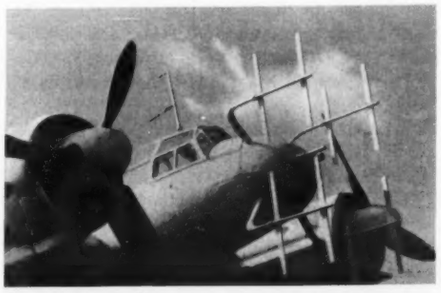


Fig. 11 : Aerial system of the " Lichtenstein SN 2 " airborne radiolocation set for night-fighter aircraft. At wavelengths which were spread between 2.0 metres and 3.0 metres, the range was between 650 feet and five miles.

activity in the field of radiolocation. C. Lorenz A. G. produced large numbers of " Hohentwiel " surface vessel detection units working on the 50 cm band, whereas Siemens-Halske built large panorama surveillance units with PPI-scope (" Wassermann " and " Jagdschloss "), as well as the small " Neptun " airborne radiolocation sets.

Enemy Interference.

As early as the summer of 1940, the " *Luftnachrichtentruppe* " and the special squads of the German Post Office had succeeded in establishing a network of highly efficient radiolocation observation posts as well as jamming stations, some of which were airborne. Command posts of this network were established at the tactical command units of the Luftwaffe. All these stations were created as a preparation for the Battle of Britain. However, in the first phase of the battle (until September 6th, 1940), in the course of which the British fighter formations were scheduled to be " bled white ", the interference stations were not allowed to go into action in order not to hinder the guidance of the British fighter squadrons towards the German fighters which at that time still enjoyed a considerable numerical superiority.

By 1942, things had changed, however. Germany was being subjected to regular bombing attacks and defended herself with night-fighters, *Flak* and efficient systems of radiolocation. If the British formations were not to be decimated over Germany, Britain had to find means of piercing the German radiolocation screen. The British answer to the German radiolocation system was the use of jamming transmitters (mostly airborne) and the mass jettisoning of metal-coated paper strips which in Germany were called " *Düppel*, " after an anti-aircraft position known by that name.

The danger of interference transmitters became a tangible fact when, in 1942, the British carried out a clever Commando raid on a radiolocation post of the German aircraft warning system at Dieppe and, in the face of violent opposition, captured certain elements of a " Würzburg " unit. The Germans immediately initiated a wavelength changeover programme (" *Wismar* "). Thousands of " Würzburgs " and " Freyas " were to be shifted around 2.40 metres and 50 cm by means of accessory devices. At the same time, new VHF and UHF elements were developed for both instruments which, by continuous adjustment, made it possible to change the wavelength in a single operation, in the same way as in normal wireless apparatus.

The danger presented by the metallised paper strips, too, was recognised at an early date, but Field-Marshal Goering initially forbade any mention of the name " Düppel " and any attempt at eliminating the strips, in order not to draw the enemy's attention to the great danger the device represented for the German defences. For this reason, it was not possible to test any counter-measures during the initial period.

British interference transmitters and metallised paper strips were first used with vast success during the attack on Hamburg of July 25th, 1943. When, later on, wide strips adjusted to the wavelength of the " Lichtenstein SN 2 " were employed, German radiolocation was severely handicapped. Countermeasures were now being developed with great energy but they produced satisfactory results only after overcoming many difficulties.

The only defence against jamming was the changing of wavelengths. However, the production of the necessary accessories and the re-equipment of all radiolocation posts in an area extending from Norway to Africa was a giant undertaking. To counter the " Düppel " danger it was decided to use the " *Doppler* effect ", resulting from the motion of the aircraft in relation to the floating paper strips. It was evident that, similar to the whistle of a moving locomotive in relation to a stationary observer, there had to be an apparent increase or decrease in the frequency. *Dr. Fack* developed a very simple procedure to determine this Doppler effect. Since the pip representing the aircraft on the scope of the " Würzburg " cathode-ray tube then assumed the aspect of a louse, the system was called " *Würzlaus* ". It permitted the trebling of the efficacy of the equipment. Engineer *Kettel* subsequently succeeded in separating the " Doppler " frequency and using it directly for measuring

Fig. 12 : Tower of the first " Panorama " unit for air district surveillance at Dremmen. The towers were later found to be unnecessary (see Fig. 14). The range was about 200 miles, wavelength 2.40 metres.

Fig. 13 : Rotatable antenna array on the platform of the tower at Dremmen.

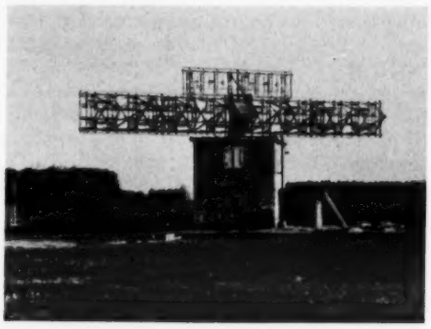


Fig. 14 : Standard version on the " Panorama " surveillance unit was designated " Jagdschloss " and scored the same degree of success as the Dremmen equipment. About 15 installations were built and operated on variable wavelengths between 2.0 metres and 3.0 metres. It was planned to convert the equipment to 9-cm wavelength in 1945.

purposes. This method (named " *K-Laus* ") made it possible to improve tenfold the ability to " see through " the metallised paper strip veil.

Considerable concern was caused also by enemy interference with the " Freya " and " Panorama " units by means of aluminium foil strips. Panorama stations were built after 1942. Large antenna arrays were first rotated on a high tower (Figs. 12 and 13), but this was soon found to be unnecessary and they were installed on small stone buildings. The echoes were registered with the so-called " Star Recorder " on a PPI scope. Installations of this type made possible a panoramic view up to 185 miles range. They were called " *Jagdschloss* " (Fig. 14), and about 15 sets were put into operational use. As their wave length was similar to that of the " Lichtenstein SN 2 ", they were jammed like the latter by broad aluminium foil strips. During mass raids the entire route of the attacking formations finally became visible on the PPI scopes (" *Mutter* " and " *Tochter* ", or " Mother " and " Daughter ") as wide trajectories provoked by the metal foil strips. Counter measures were elaborated, including one which differentiated the moving aircraft from the stationary foil strips by changing their colour. However, they did not become operational on any scale. Nevertheless, the approach of enemy formations could always be recorded until the last, especially because the German radiolocation observation sets which had been developed in the meantime (e.g. " *Korfu* ") easily recorded the approach of the carelessly emitting enemy H2S (" *Rotterdam* ") aircraft.

On the whole, however, the enemy's interference efforts were successful both directly and indirectly, the latter through the disturbing effect they had on the industry and the operational units as a result of the continuous addition of increasingly complicated supplementary equipment. On the other hand, the metal foil strips had a disadvantage also for the enemy : the wide metal-foil trajectories unerringly kept the German night fighters on their course, until the enemy resorted to the employment of special decoy aircraft for the purpose of camouflaging the approach route of the main formation.

The Latter Stages of the War

Germany found herself in an extremely difficult situation : the Western Powers had taken the initiative in the air war. Research centres, industries, radiolocation installations and communications were being attacked systematically. Plants had to be shifted, camouflaged, rebuilt or protected by decoys or shadow installations. The German front extended from the North Cape to the Franco-Spanish frontier, the area demanding protection practically over the whole of Europe. Added to these problems were worries over raw material procurement and the continuous recruitment of scientific and industrial personnel, as well as personnel of the Luftwaffe warning and special services, for first-line duty on the Eastern front.

In collaboration with the scientific, industrial and military authorities, a first attempt was then made to consolidate the necessary research, development and production tasks in an integrated *radiolocation programme*. A so-called " *Rü-Funk-Aktion* " was carried out, which resulted in the recall of about 15,000 electronics engineers, designers and mechanics from first-line service. The overall management of this programme was entrusted in December, 1941, to *General Martini*, " Special Commissioner for High Frequency Engineering " and Chief of the Luftwaffe Communications Services; control of research was given to the " Commissioner for High Frequency Research, " originally *Dr. Plendl* and subsequently *Prof. A. Esau*.

The radiolocation war, up to 1943, can well be characterized as a " war of attrition ". With great obstinacy both sides fought an offensive and a defensive war in a field of engineering which on the whole was determined by pre-war achievements of physical research.

A decisive turn of events in the whole field of radiolocation engineering occurred as a result of the adoption of *centimeter wave lengths* in Britain. In that country radiolocation had started with very long waves (about 12 metres) which for surface vessel detection had gradually been reduced to about 1.50 metres. But not even this wave length was short enough, and for this reason the revolutionary decision was made in good time to adopt the sufficiently short wave of 10 cm in conjunction with the rotating antenna for panorama purposes. Germany, on the other hand, had started with relatively short waves (50 cm), at least for the " Würzburg " equipment. The compulsion to use shorter waves, therefore, was much smaller, and an extremely grave error in scientific evaluation subsequently prevented even the experimental use of shorter waves. Certain responsible quarters held the opinion that such short waves would be unsuitable for radiolocation purposes, notably because of the deflectory effect of the target aircraft.

At a meeting convened by Dr. Plendl at Wannsee at the turn of 1942–43, which was attended by senior military personalities and engineers, it was asserted that while it was true that the efficiency of reflection increased with shorter wavelengths, this curve dropped sharply at about 20 cm and that shorter waves were therefore useless. The result of this misconception was that in Germany all work in the field of SHF communication techniques was abandoned. No SHF radiolocation work was then in progress.

A few weeks after this meeting, on February 2nd, 1943, a bomber shot down near Rotterdam yielded an instrument which was immediately studied at the Telefunken laboratories at Zehlendorf and was disclosed to be a radiolocation set working on a 9-cm wave length with the considerable power of 10 kW. At first the operating principle was not clear, as the cathode ray scope had been destroyed. Very soon, however, the full significance of this instrument, which was called " *Rotterdam* " after the place where it had been found, was understood.

In his book " One Story of Radar ", *A. P. Rowe* dramatically describes the development of this equipment. Originally it had been designed for submarine detection with a surprisingly long range of 45 miles. The decisive principle embedded in it was the rotating antenna, which made it a panoramic viewing device. In contrast, a wavelength of 4 meters was selected in Germany for the " *Lichtenstein S* " surface vessel detection set in the belief that this provided sufficiently wide antenna characteristics. To cover an adequate area of the sea surface was consirelevant part of the sea surface was considered possible only with longer waves and rigid antennae. The correct principle, namely, narrow antenna characteristics on short waves in conjunction with a rotating antenna, had been discovered in England. Operated over land, this type of airborne equipment had qualities even more surprising than over the sea : it clearly showed the contours of lakes and rivers on its PPI scope.

When photographs of these results were first shown to A. P. Rowe, he realized that a turning point had been reached in the war : water surfaces refracted the rays at right angles to the surface, whereas mountains or houses reflected them back to the aircraft. On the scope any transition from land to water, therefore, appeared very clearly ; but even complexes of buildings stood out from the surrounding earth surface.

In England the tremendous importance of this airborne equipment in the air campaign against Berlin and Eastern Germany was fully appreciated, as normal radio aids to navigation were effective only as far as the Ruhr. British experts warned against using this airborne radar, which was called " *H2S*, " too early over land in order to prevent it from falling into German hands ; they were ignored, however. In effect, the device found at Rotterdam, designated " Experimental 6 " (delivery date : December 24th, 1942), thus disclosed the new technique to the Germans in every detail at an early stage.

The H2S (" Rotterdam ") instrument was repaired and copied at an accelerated rate at Zehlendorf. But the completed instrument was again destroyed during a bombing raid in March, 1943, as a result of which there ensued a considerable delay. A " Rotterdam " working-group, headed by the author, was charged with the task of studying the importance of SHF waves, which now had forcibly been brought to our attention, and to introduce the new technique in all fields. In the course of 1944, a very much refined American instrument (working on 3-cm wavelength) was found and designated " Meddo " after its place of capture ; however, it did not offer any more surprises of a fundamental nature.

The H2S (" Rotterdam ") equipment proved the usefulness of 9-cm waves for airborne ground observation instruments with PPI scopes. At first, it was not clear whether the transmitter power or receiver sensitivity on the one hand and the reflection characteristics of an aircraft on the other would make this wavelength suitable also for normal radiolocation purposes.

Those German scientists opposing the use of SHF waves declared it a waste of manpower to devote any amount of energy to the study of these problems. When a SHF unit was finally built into a " Würzburg " reflector, they asserted on the morning of the test-day, December 22nd, 1943, that the instrument would have a range of only five miles.

An hour later the actual range was found to be equivalent to the usual range of the " Würzburg, " namely, 20 miles. This caused a landslide in Germany's entire radiolocation theory. The author proposed on January 4th, 1944, that the entire radiolocation equipment available for any purpose in Germany should be converted to SHF waves in three steps, around 9 cm, 3 cm and 1 cm wavelengths. All units were to have the same components, apart from antennae, interchangeable high frequency elements and their cathode ray oscilloscopes, designed for the specific use of each unit. A detailed programme was established for the construction and introduction of large panorama units, anti-aircraft radio gun sights, airborne panorama sets, radiolocation units for large and small ships, submarines, coast protection installations and the " Funksehen " (radio vision) system. These plans provided for a rapid and uniform conversion to centimeter wavelengths by a stringent concentration of all tasks of radiolocation and by the adoption of interchangeable elements *(Bausteinprinzip)*.

The Stage Reached by the End of the War

The most successful development was the " *Egerland* " *anti-aircraft battery unit* which operated on a 9-cm wavelength. It consisted of a panorama unit which could be switched to a range of 20 miles or 40 miles *(" Kulmbach ")* and a battery sighting unit *(" Marbach ")*, using a 15-ft. reflector with a defocussized antenna. The antennae were remote-controlled, so that the instruments themselves could be buried or housed inside strong fortifications. The panorama unit *(" Kulmbach ")* provided the commanding officer of the anti-aircraft " *Grossbatterie* " with an overall view of the air space, at an adequate distance from the battery itself. If he decided to fire at a selected target, he could turn the

" *Marbach* " battery-sighting unit into the corresponding azimuth by means of a servo unit, and on the basis of the " Kulmbach " scope he then merely had to adjust the " Marbach " set for elevation. Despite the small beam (about 1½ degrees), detection was easy. Two complete installations were manufactured and were used near Berlin in the course of several large air-raids until they were finally blown up. The panorama scope always recorded the aircraft in the form of brilliant pips amidst the " fog " produced by the cloud of metal foil strips. The relatively small number of metal strips within the narrow radio beam of both units, the sighting set and the panorama equipment was not sufficient to produce effective interference, and this especially since the enemy strips were adjusted for use against the " Würzburg " frequency. A theoretical examination, which in the meantime has been chosen as the subject of a doctor's thesis by *Dipl.-Ing. Stepp*, shows that the effectiveness of the metal foil strips drops in proportion to the decrease in wavelength, which means that a greater quantity of strips will be required to obtain a given degree of jamming. This gave rise to the hope that the operating efficiency of the " Egerland " unit could be maintained also in the face of great specific density of the metal strips by means of additional elimination of all echoes without Doppler effect. The danger represented by jamming transmitters was considerably smaller in the case of SHF waves, because the band width for jamming remains constant whereas the higher frequencies offer more possibilities of wavelength variation. A special cathode-ray oscilloscope, developed by *Dr. Steimel*, provided for high-frequency elements capable of immediate continuous changes in wavelength. Tactically, therefore, the " Egerland " unit, considering its relative immunity to jamming transmitters and metal foils, presented a decisive advance.

The projected large SHF panorama units (for use on the ground), which were under construction in western Germany and at Brück i. d. Mark, did not reach the operational stage.

Airborne panorama sets for bombers, similar to the H2S (" Rotterdam ") units, which were developed under the designation " *Berlin* ", no longer were of any practical interest for Germany in 1944, since German bombers were then hardly used for long-range missions. Of much greater importance was the replacement of the " Lichtenstein SN 2 " with an airborne SHF set (designated " *Berlin N* "). Ten units of this type were used by German night-fighters and resulted in several successes. The equipment featured an antenna in the form of a concave reflector of 2 ft. 6 in. diameter which was remote-controlled by a stick. The necessary searching action provoked no unpleasant sensation to the pilot, since it made it possible to follow any lateral movement by the enemy with particular clarity. The instrument suffered practically no ill-effects from metal strips. Automatically - searching antennae, designed to obviate the necessity for stick-control, were under development.

The German *Navy* was most severely hit by Britain's advance in the field of radar engineering resulting from the employment of SHF waves. Therefore it was all the more grateful to be equipped with instruments of this type itself. The " *Berlin S* ", designed for use aboard motor torpedo boats, on one occasion enabled the leading vessel of a flotilla to guide a group of about 100 boats (carrying 20,000 refugees) in complete darkness through an extremely narrow lane in a minefield ; the limiting buoys were clearly visible in the PPI scope. Two submarines were equipped with " *Berlin U* " units in addition to their periscopes and, in the course of cruises in the Bay of Lubeck, clearly reproduced the contours of the bay, every buoy, every vessel, in addition to a convoy sailing at a distance of more than 12 miles. The larger antenna of a similar unit was installed on the heavy cruiser " Prinz Eugen ".

SHF equipment proved to be of outstanding value also for the shore stations of the Navy. Such units, built into the 23 ft. reflector of the " Würzburg " giant, picked up ships sailing up to 45 miles off the coast and were intended to help in the blockade of the Skagerrak, between Norway and Jutland. The blind spots in the centre were covered by the fighter guidance vessel " Togo ".

Two systems, abandoned at an early stage of development, had aroused particular interest in the Navy: the " *Barb* " gun-sighting method and the " *Funksehen* " (radio-vision) system. The former indicated the distance from the target of the water columns provoked by the bursting shells and thus provided great facility of correction. The radio vision system, based on a suggestion of *Professor Kohl*, for the first time made it possible to " feel " a ship in the Bay of Lubeck. With 9-cm waves in the 23-ft. reflector the lowering and hauling up of a launch alongside the large hull was clearly observed. Through the fitting of a 1.5-cm unit, it was hoped to improve perception to the point of recognition of the vessels' contours, masts and funnels.

For the 9-cm radiolocation sets, production of which had been initiated on a broad basis, a 100-kW high-frequency element was ultimately completed in addition to the 10-kW element. A 3-cm. multi-purpose high-frequency element also was available. Furthermore, an airborne 1.5-cm unit (called " *Eule* ") produced impeccable results against other aircraft at ranges of up to 2 km. In conjunction with low-antenna output this instrument was intended for the determination of the correct distance for the release of air-to-air rockets against enemy bombers.

Passive Radiolocation

Observation of and interference with enemy radiolocation techniques was initially conducted on a considerable scale along the Channel Coast and produced an important result, namely, the putting out of effective action of the entire British radar network during the time when the battleships " Scharnhorst " and " Gneisenau " were brought back to Germany through the Channel from Brest (from February 18th to 20th, 1942). The British subsequently carried observation receivers on their bombing raids for the purpose of determining the " Würzburg " and " Freya " wavelengths, on the basis of which the British airborne jamming transmitters were then to be brought into action.

On the whole, the passive radiolocation methods were a failure in the employment of the German Navy and a conspicuous success when used by the *Luftwaffe*. When the use of SHF waves had officially been declared as impracticable in Germany, while British Coastal Command aircraft were systematically searching the oceans with

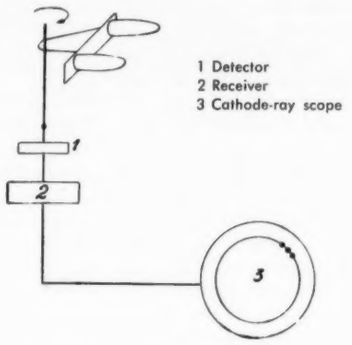


Fig. 15 : Diagram of the " Naxos Z " warning and homing receivers for night-fighters which were used against bombers with the British H2S (" Rotterdam ") 9-cm equipment or the American H2S (" Meddo ") 3-cm units. Range was 30 miles. The cathode-ray scope merely indicated direction but not distance.

Fig. 16 : Installation of the " Naxos Z " in a Messerschmitt Me 109 G. Such units were used especially in " Wild Pig " operations, i.e., in single-seater night-fighters operating within the target range of Germany's own anti-aircraft guns.

their 9-cm equipment, the fate of the German submarine service was sealed. Although the German submarine losses were high even as a result of the 1.50-metre Air-to-Surface-Vessel (ASV) equipment, the greater range, the PPI presentation and the combination with the bomb-sight of the British 9-cm unit considerably increased the efficacy of Britain's anti-submarine measures. The German war diaries of those times reflect the terrors of those unexplained disappearances of German submarines. It was only following the capture of the " Rotterdam " equipment that the real cause was discovered. Production was immediately begun of simple warning receivers (" *Naxos* "), which were made part of the regular equipment of the submarines. They indicated the " Rotterdam " aircraft at a range of

5½ miles, which was just sufficient to dive in safety. These antennae were subsequently improved (under the name "*Thetis*"), ranges of up to 30 miles were achieved and the threat was eliminated in theory. In the meantime, however, the greater part of the effective submarine strength had been sunk.

Following discovery of the "Rotterdam" equipment, the night fighters were fitted with special receivers called "*Naxos Z*" (Z = *Zielflug* = homing) which had a rotating antenna (Figs. 15 and 16). The opponents of SHF engineering declared that these units would never attain a range of more than two miles. In effect, "Naxos Z" achieved a range of 30 miles, became an indispensable night-fighting weapon and produced substantial results. The same instrument, working on a wavelength of 3 cm, was used against "Meddo", the American version of H2S.

A special receiver of considerable size, the "*Korfu*" of the Blaupunkt Company, heterodyne receiver operating on SHF wavelength, produced astonishing results. Advanced "Korfu" stations registered the switching-on of the H2S units aboard British bombers still at their air bases in Britain. At precise intervals after the instruments were switched on, the bomber formations took off, night after night. Their route was recorded by numerous "Korfu" stations linked together by an elaborate telecommunications system. Of all observation methods, the "Korfu" network provided the best picture of the air situation. The question which then faced the British was whether the advantage provided by the H2S offset the disadvantages resulting from their observation through "Korfu" or "Naxos Z" units. Towards the end of the war the British H2S units were used increasingly rarely.

It is certain that a radiolocation observation system requires complete coverage of all frequencies by receivers with and without D/F accessories, on the ground, aboard ships and aboard aircraft. These instruments are a prerequisite for detection and warning and for the use of jamming transmitters, with which some of them must be coupled directly.

Passive radiolocation also included the camouflage of water-surfaces and the erection of decoy targets. The former was effected with the aid of special reflectors *(Tripel)*. As a result, the Wannsee and Müggelsee showed up in the H2S unit with entirely false contours. Similarly, "artificial" targets were built up on land and decoy targets established above water to lead the "Rotterdam" aircraft astray. Floating tar-, gets, or targets suspended from balloons released in considerable numbers by a submarine (designated "*Bolde*" i.e. liars), understandably succeeded in diverting attacks carried out in no-visibility conditions. For the protection of submarines of later types, furthermore, the "Schnorkel" was covered with a layer absorbing the SHF waves ("*Schornsteinfeger*" = chimney-sweep), which in theory reduced the range of enemy airborne radiolocation equipment at least by half.

Radiolocation for Rocket Guidance

The development of the V-2 led to the adoption of the principle of radio guidance at an early stage. To begin with, a radio range system was created in which the guidance plane was formed by two 7-cm transmitters which acted on a rocket-borne receiver *("Victoria")* in such a way as to maintain the V-2 constantly at the same distance from the two transmitters.— *General Dornberger*, the military head of the V-2 development project, demanded that this system, which very easily could have been jammed or otherwise interfered with, be replaced with a "radio gun" *(Funkkanone)* which had yet to be developed. For this purpose the beam guidance of the "Würzburg" reflector with rotating dipole was considered suitable, and a special receiver had to see to it that in the case of deviations from the axis of the beam the control surfaces carried out corrections to guide the missile back into the beam. Preliminary tests were made at Peenemünde with a "Würzburg Giant" with great success. A final version was ultimately developed to operate on a wavelength of 20 cm but did not go into operation before the end of the war. The ground control station consisted of a mobile set with a 13-ft. reflector. It was to go into operation as soon as the V-2 had been auto-piloted from its vertical position into its trajectory. The "wireless gun barrel" then took over the guidance until the rocket received the signal "end combustion" which was transmitted automatically on the basis of distance measuring.

More difficult was the task of guiding *anti-aircraft rockets*, such as "*Wasserfall*", "*Enzian*", "*Schmetterling*" and "*Rheintochter*," to their targets. Only very few full-strength anti-aircraft batteries complete with guidance equipment (for four firing points) were delivered. A normal *radiolocation set* ("Würzburg") served to detect the target in a cathode-ray oscilloscope with a hair-cross arrangement and was constantly focussed on the target in such a way as to ensure the latter's being held in the centre of the hair-cross. A *radio command unit*, which also resembled the "Würzburg", permitted the anti-aircraft rocket to be guided in elevation and azimuth by means of a stick control. A rocket-borne *receiver-transmitter* constantly recorded the position of the rocket on the hair-cross viewing instrument. With the help of the control stick, the pip denoting the anti-aircraft rocket could be made to cover the bright sport provoked by the enemy target aircraft. For guidance through the last few kilometers to the target the rocket contained a homing device *("Schnüffel")* which controlled the rocket until the detonation of the fuse occurred.

Similar problems arose in the development of a system for the guidance of *Air-to-Air rockets* for day and night operation against enemy bombers. Initially, the air-to-air rocket was guided by a wire which reeled out from the rocket. Since this method presented considerable hazards to German ground installations, particularly high tension cables, development was switched to a radio device. This was based on the stick control adopted for guided bombs (HS 293 and Fritz X). The airborne transmitter (operating on a 7-m wavelength) was called "*Kehl*", whereas the rocket-borne receiver was desginated "*Strassburg*". This system resulted in great firing accuracy and towards the end of the war was converted to a 25-cm wavelength.

Concluding Remarks

Winston Churchill's war memoirs and the opinions expressed by British experts such as *Sir Robert Watson-Watt*, and *Dr. Robert F. Jones* have confirmed that at the outbreak of war Germany was equal to and in many respects even ahead of Britain in the domain of radiolocation. It was not until 1942 that development in Britain was fully abreast of that in Germany. And in spite of the bombing raids and all the other difficulties it was possible in Germany, as late as the last year of the war, not only to maintain a radar air surveillance system sufficient for aircraft detection and anti-aircraft defence but also to apply the new SHF technique for every imaginable purpose. On the other hand, I have had to emphasise that the temporary backwardness of German radiolocation since the middle of 1943 was due to a severe misintepretation of scientific data and to disturbances in team work as a result of dictatorial interference of the authorities.

A field of activity like radiolocation, in which progress must be made continuously and on a wide front, demands the full collaboration of all participants, from research to development, production, testing and operation. Unhampered collaboration is of the greatest benefit to science also in peacetime. Team work is the most natural working principle in England and the United States. The team which the British scientists Watson-Watt, Rowe and their collaborators formed in the field of radiolocation with the strong support of Churchill and Professor Lindemann is eloquent proof of this fact. In Germany this kind of collaboration will urgently be needed in the country's rehabilitation and reconstruction. Only in this manner will it be possible to create acceptable living conditions for the 45,000,000 inhabitants crowding the small space of Western Germany.

Work in the field of radiolocation is banned in Germany for the time being. The outstanding importance of this technique for all purposes of navigation and safety in the air, on water and on land will no doubt result in a modification of this ban on some future date. It is to be hoped that Germany will again be able to permit its capable scientists and engineers to devote themselves to such tasks. It should not be forgotten that, before World War I, it was the German physicist and Nobel prize-winner *Ferdinand Braun* who pioneered a universal advance in international science and electrical engineering with the development of his cathode-ray oscilloscope—that device which today helps, in practically unchanged form, to save human lives in the guise of the "Magic Eye".

Progress in Pictures

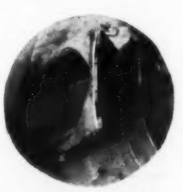
Detachable Cargo Pods

By the time this issue is published, a cargo aircraft which may well prove to be of revolutionary importance in military and civil air transportation will in all likelihood have started its flying trials : the Fairchild XC-120 " Pack Plane ". Essentially similar to the well-known twin-engined C-119 " Packet ", the C-120 features a detachable fuselage. For air lift operations or for scheduled cargo services, its removable freight container can be loaded like a motor-trailer, if desired outside the limits of the airport area. Prior to take-off it is manoeuvred under the aircraft proper on its detachable wheels *(right)* and fixed to it in a matter of minutes. Upon landing the container is removed and the aircraft returns to the point of departure either without its pod or carrying another previously loaded with return freight. Other possibilities lie in the use of the container as a first-aid or a radio station, as a field headquarters or a repair shed. From the engineering point of view the design presented many difficulties. The aircraft's nose-wheel unit could not be mounted to the detachable fuselage but had to remain fixed to the aircraft proper. The final solution was a four-strut eight-wheel landing-gear, the forward wheel pairs of which are retractable into the engine nacelles like the main gears mounted further to the rear.

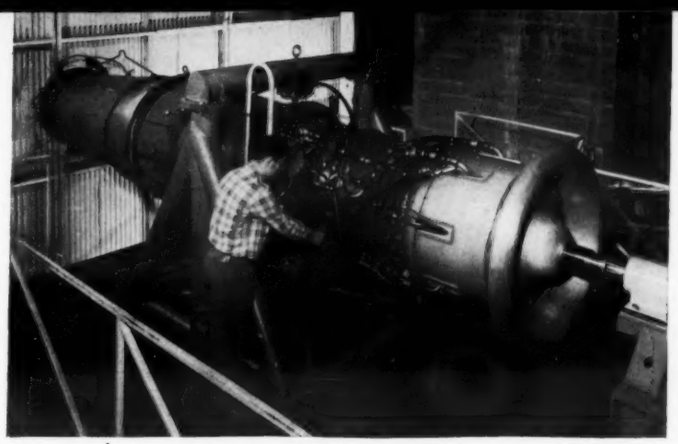
Compound Engines in Operational Use

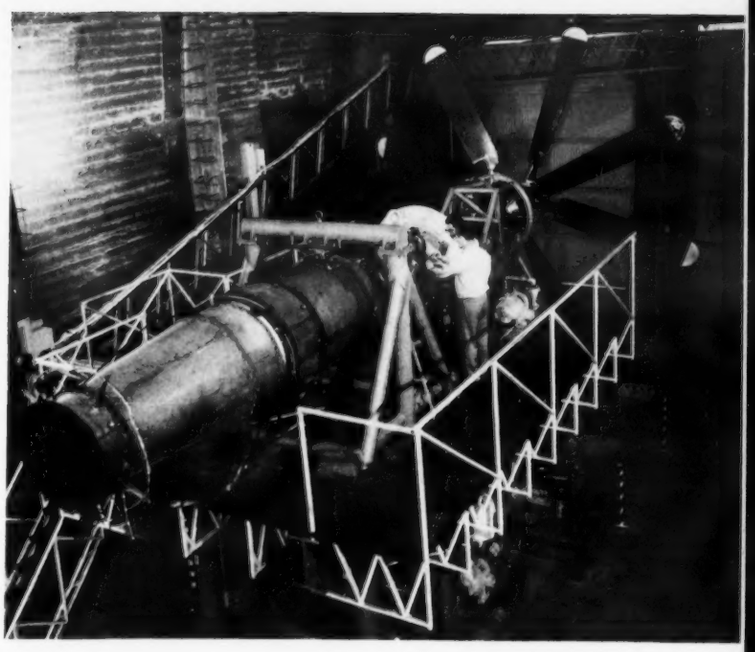
The Lockheed P2V-4 anti-submarine aircraft, one of the latest versions of the P2V " Neptune " twin-engined long-range patrol bomber, is being equipped with Wright " Turbo-Cyclone 18 " Compound engines which are now coming off the production line. The units are of the well-known Wright " Cyclone 18 " twin-row radial series of 2,700 h.p., but the exhaust gases of three groups of six cylinders each are ducted into an exhaust gas turbine *(circle)*.

Unlike turbine superchargers, the three turbines are not coupled to blowers but deliver their power through shafts and gears back to the engine crankshafts and thus to the airscrew. Even after leaving the turbines, the gases provide a residual thrust, as a result of which the total output of the engine is boosted to 3,200 h.p. This increase in power raises the speed and take-off weight of the aircraft and hence improves its range and combat power. — Not to be confused with this combination is the fitting of



exhaust gas ejectors to engines of the same series. Experiments with the latter arrangement are at present being conducted by KLM Royal Dutch Airlines with a Lockheed " Constellation ". In this version the exhaust gases emerging from the cylinders, in conjunction with the cooling air sucked into a jet pipe by ejector effect, produce additional thrust upon leaving the tail pipe, similar to the arrangement adopted in the " Convair-Liner ".



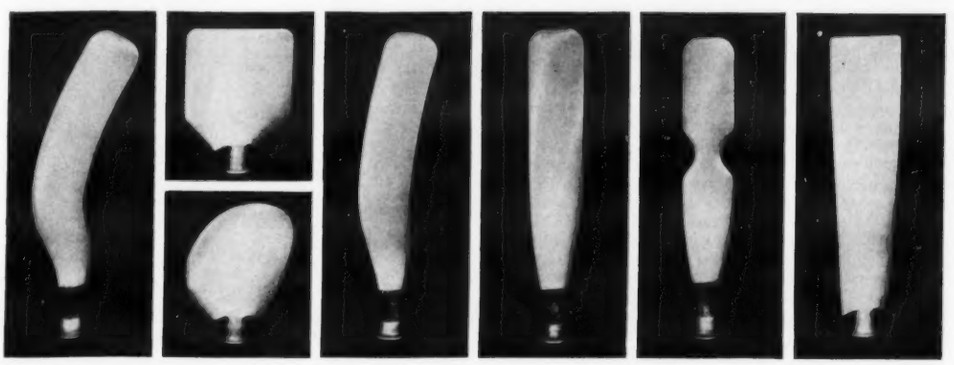


A 10,000 h.p. Aircraft Turbo-prop

After years of test-bench experimentation, the Turbodyne Corporation, a subsidiary of Northrop Aircraft, has developed a 10,000 h.p. propeller turbine to the point where it could be fitted experimentally to an aircraft. It is the most powerful turbine ever built for this purpose. On the other hand it should not be overlooked that a straight jet engine of 7,000-lbs. thrust, such as are in production today, would deliver an equivalent power of the same order at a speed of 425 m.p.h. Yet, there is hardly an aircraft in the United States whose maximum speed would still permit the use of airscrews and at the same time would require such a high output from a *single* power unit. A three-engined B-36, a twin-engined "Stratocruiser", a single-engined Douglas DC-6 . . . ? A special feature of the Turbodyne XT-37 lies in the fact that it can be used in conjunction with a pusher airscrew.

The Ever-Young Propeller

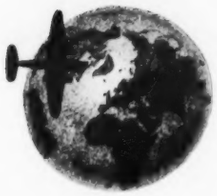
Increased power outputs and flying speeds, such as are being attained with large gas turbines, present the airscrew designers with new problems. It would be extremely profitable to them if they were able to develop propellers capable of operating with good efficiency at the speeds reached today by jet-propelled aircraft. For take-off, the propeller will always be superior to the straight jet, since it furnishes greater thrust efficiency at lower speeds. But since the propeller blade tip speed is added to the forward speed of the aircraft, the propeller tips attain the speed of sound in high-speed flight long before the aircraft's wings. Experiments are being made to overcome the disadvantages of supersonic flow by bending the propeller tips backwards, on the principle of the sweep-back on aircraft wings. Other tests are being made to keep the blade-tip speed low, without loss of efficiency, by the employment of short, wide paddle-type blades. Still other designers have made tests with designs in which the extreme portion of the propeller blade, which operates in the supersonic region, is separated from the inner portion through a special constriction. All these are questions which the Hamilton Standard propeller division of United Aircraft Corporation has tested in a long series of wind-tunnel investigations. The results have shown that the most promising designs still are those large rectangular metal blades of thin airfoil section and relatively large area which have become fashionable in the past few years. Even at speeds of 600 m.p.h. such propellers continue to operate with a tolerable degree of efficiency, and it is not excluded that they can be further developed for use at supersonic speeds.



A variety of experimental airscrew shapes. Best results were obtained with the blade at extreme right

Contra-rotating 8-blade airscrew of 14 ft. diameter for a turbo-prop developing more than 5,000 h.p. in bench-tests.

Wide, rectangular paddles form the contra-rotating 6-blade propeller of the new Douglas «Skyshark» fighter which is powered by a 5,500-h.p. gas turbine.



What's in the air ?

GROWING PAINS IN WORLD AIR TRANSPORT

One after the other the airfaring nations of the world find themselves obliged to come to the aid of their air transport systems to enable them to get over their growing pains. This applies both to the Old and the New Worlds. When the *Brazilian Government* decided to slash its annual airline subsidies from 75,000,000 cruzeiros to 35,000,000 cruzeiros, it ran into the most vigorous opposition in Parliament and leading business and industrial circles. Opponents declared that Brazil's international services might not be able to carry on if their subsidies were cut. *The Argentine Government* allocated a sum of 13,000,000 pesos to cover the Argentine State-owned airlines' deficits for the first two months of the year. The whole of the fiscal year is expected to result in a loss even exceeding the 100,000,000-peso deficit of 1949.

In Europe, the Swedish *A. B. Aerotransport*, which during the first four months of 1950 lost roughly 500,000 kroners in the operation of its two major domestic services (Stockholm-Malmo and Stockholm-Lulea), applied to the Government for a financial allocation in that amount, notwithstanding the fact that the Swedish Riksdag previously had pronounced itself against the granting of such a subsidy.

The Dutch Government has decided to help KLM Royal Dutch Airlines, which lost Fl. 39,500,000 in 1949 (against a Fl. 173,000 profit in the preceding year) with its refinancing programme. The deficit was due largely to operating losses on the Amsterdam-Batavia route resulting from political changes (Fl. 28,200,000) and from the unfavourable effects of the guilder devaluation. The government now proposes to grant KLM a direct subsidy of Fl. 27,500,000 and an interest-free loan of Fl. 10,000,000. In addition, the government will provide new capitalization in the amount of Fl. 65,000,000. KLM's capital would thus be owned by the State to the extent of about 90 per cent. — The financial reconstruction of Swissair has been postponed until the end of the Parliamentary holidays at the end of September. Plans provide for Government equipment aid under a scheme whereby the Government would purchase new aeroplanes which would then be leased to the airline. For the time being, the company has signed a contract for two Douglas DC-6B long-range transports, but this contract will later be taken over by the State. The nationalization of Swissair in any form has so far been declined by the leaders of the country's economy. To study and clarify all problems connected with Swizerland's civil aviation (air traffic control, subsidies, ground organization, legislation, etc.) a Civil Aviation Commission of 15 to 21 members is to be appointed, on which will be represented the economic interests involved, the air carriers as well as the Federal and regional authorities.

This short summary of events during the past month shows that the problem of State subsidy has not been limited to a single country and that civil air transport's present difficulties are hardly the result of inefficient management of the airlines concerned. Irrespective of some opinions, international civil aviation still is in a state of infancy. This applies even to the *United States*, where discussions concerning the optimum level of passenger and cargo rates continue and where a show-down between scheduled and non-scheduled air carriers is now in progress. The situation has again shown that in the problem of tariff reductions the U.S. Civil Aeronautics Board is observing an extremely conservative attitude. Braniff, Delta, Eastern and National were not allowed to cancel their " luxury supplements " for schedules flown with Douglas DC-6 or " Constellation " equipment. Although earlier air coach licences have now been extended to September 30th in the case of Capitol, Northwest and TWA, an application for such service submitted by Eastern Air Lines has been turned down. Ralph S. Damon, TWA president, has again warned against precipitated fare cuts which would reduce air transportation to a " bargain basement " operation.

As regards non-scheduled operations, C.A.B. continues to proceed against irregular operators clandestinely engaging in scheduled flying or disregarding rates and tariffs approved by the Civil Aeronautics Board. Incidentally, the " New York Times " reports that of about 100 irregular carriers formed at the end of the war, only about 15 have survived the tough post-war competition and are operating with a reasonable degree of success.

Left: *Ralph S. Damon*, President of Trans-World Airline, who has just been elected a member of the Board of Directors of the Commerce and Industry Association of New York, has warned against premature airline fare cuts which would reduce air transportation to a " bargain-basement " level.

Right : The man directing the U.S.A.F.'s participation in South Korea : *Lieutenant-General George E. Stratemeyer*, Commanding General of the U.S. Far East Air Forces.

AVIATION ORGANIZATIONS

The fourth *Annual General Assembly of the International Civil Aviation Organization* met in Montreal from May 30th to June 22nd. As was to be expected, the President of the ICAO Council, Dr. Edward P. Warner, has been re-elected for another period of three years. The Council, newly-elected for a similar period, comprises delegates from twenty member countries. No sensational decisions were adopted. The conclusion of a *multi-lateral convention* on commercial traffic rights in international air transportation, efforts toward which have been made for years, was advocated particularly by France and Mexico, whereas the U.S.A. and Great Britain argued against it in view of present difficulties in its practical execution. The Assembly finally recommended further benevolent study by member nations. — The French resolution that *groups of countries should establish international airline companies to serve their common interests* was backed by Argentina, Great Britain and Mexico, whereas the United States, Australia, India, Ireland, Egypt and the Netherlands supported the Council's recommendation to take no action at the present time. The problem of the *Rome Convention of 1933 and the Brussels Protocol of 1938* (liability for damage to third parties on the ground) were referred to the Legal Committee of ICAO, as the drafts had not been submitted to member countries within the prescribed four-month period.

Douglas XA-2D " Skyshark "

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In Stockholm the 43rd International General Conference of the *Fédération Aéronautique Internationale* (FAI) was opened on May 31st by the Crown Prince of Sweden. In his annual report, the Secretary-General of KSAK, Royal Swedish Aero Club, has disclosed that the total membership of clubs affiliated with FAI was now about 200,000.

Dr. Enrico Celio, Swiss Minister of Posts and Railways (which controls the Federal Civil Air Office), will leave the Government at the end of September to become Swiss Minister in Rome. During his period of office Switzerland's international airports, Geneva-Cointrin and Zurich-Kloten, were inaugurated. His department also was responsible for the adoption of the new Swiss Civil Aeronautics Act.

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Critics may observe that the practical results of international conferences, organizations and associations has been negligible so far. It should not be overlooked, however, that every international working group provides opportunities for international comprehension and progress, though frequently in a restricted technical field.

One of the best known international aviation pioneers, Dr. Albert Plesman, President-Director of KLM Royal Dutch Airlines, recently announced a plan for *international world cooperation*. Plesman's blueprint is founded on an eminently practical basis. He considers that international cooperation can best be assured through the joint public works projects, such as the construction of tunnels and canals, or the joint solution of emigration problems and the development of backward territories. One field of activity might be the improvement of ground facilities in international civil aviation.

GROUND FACILITIES

News concerning the construction and expansion of airports in every corner of the world have been so profuse in the last month that it is impossible to give all the details ind this brief review.

For the *Australian* Department of Civil Aviation, a total of 14 airports are now under construction (5 in New South Wales, 1 in

Hawker P. 1081

Victoria, 1 in Western Australia, 2 in South Australia, 1 in Queensland, 2 in the Northern Territory and 2 in New Guinea). Another 49 are being built by local authorities or private individuals.

The *South African* Railway Administration, which is also the governing body of air transportation, is pushing ahead its airport building programme. Of three large airports now under construction (Johannesburg-Jan Smuts, Durban-Reunion and Cape Town-Belleville), for which £12,000,000 is to be spent, Johannesburg will be the first to go into service. Transport Minister P.O. Sauer has estimated that aerodromes in the South African Union will require an annual subsidy of £500,000 to £ 600,000.

Amsterdam municipal authorities have allocated a further sum of Fl. 12,750,000 for the expansion of Schiphol Airport, on which a total of Fl. 33,000,000 has been spent since 1947. On the other hand, the Airport Committee appointed by the Dutch Minister of Communications has issued a majority opinion rejecting the plans for the construction of an additional major airport in Western Holland, as Schiphol will be fully capable of taking care of Holland's international traffic volume. This opinion seems to spell the end for the Rotterdam-Schiebeen and the Hague-Ypenburg projects until further notice.

Hearings which the Civil Aeronautics Administration started in Los Angeles on May 17th and continued in San Francisco will serve to prepare America's ground organization for the *operation of jet-propelled transport aircraft*. At about the same time a bill which would authorize the operation of *helicopter airports* on or near government buildings was introduced in the U.S. House of Representatives.

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The only exception from all this "airport-mindedness" seems to be the Clunies Ross family. To reward the seafaring George Clunies Ross, Britain made a perpetual grant of the Cocos Islands to him and his descendants in 1886. Today, the private owners of the islands are holding up the establishment of the projected Australia-South Africa air service by refusing to sell the land required for an air strip on one of the islands to the Australian Federal Government. They fear that the outside world will intrude on their isolation.

PROPELLER-TURBINE AIRCRAFT AND THE HOLIDAY SEASON

Theoretical considerations on development trends in aircraft design and similar subjects are no suitable fare for the warm season. Discussion of even the most hotly disputed question has been adjourned, namely, the introduction of propeller-turbine and straight jet airliners in air transportation. Since the experts of the IATA Companies devoted their attention to the practical problems of the future high speed, high altitude air services on the occasion of their technical conference near New York in the middle of last May, general interest has shifted from theoretical discussion, so popular during the past few years, and is now concentrated on the forthcoming operational tests of the new aircraft types. However, the Convair "Turboliner" which will be used to test the Allison T-38 turbo-prop, the power plant envisaged for most American propeller-turbine transports, will not fly before September or October. Meanwhile, the aircraft designers quietly continue to work on their new models and design variations, and Convair is reported to be working on an "entirely new" type which therefore would be completely different from the "Turboliner". The buyers for the airline companies thus have an opportunity of taking their summer holidays.

FIRST FLIGHTS

In actual practice the gas turbine is gaining steady ground also in the United States. On May 26th the first American propeller-turbine single-seater carried out its maiden flight. The machine is the *Douglas XA2D "Skyshark"*, powered with an Allison T-40 twin-turbine of no less than 5,000 h.p. Its gross weight is estimated at about 17,000 lbs. It is hardly necessary to calculate the power loading to discover that the aircraft will have extremely short take-off and rapid climb characteristics. Hence it will be particularly suitable for operation from aircraft carriers, more so even than the British Fairey 17 anti-submarine, two-seater of 2,500 h.p. and the Westland "Wyvern" single-seater 4,000 h.p. torpedo-carrier, both of which landed on and took off from and aircraft carrier in the third week of June as the first propeller-turbine aircraft to accomplish this feat.

Blackburn & General Aircraft GAL-60

Gloster "Meteor 11" night-fighter

On June 4th the *Republic YF-96A* swept-wing jet fighter, a development of the well-known F-84 "Thunderjet" took to the air for the first time.

On June 17th this aircraft was followed by the *I.Ae.27 "Pulqui II"* jet fighter, which made its initial flight at Cordoba, Argentina. Its design is attributed to Professor Kurt Tank, creator of the German Luftwaffe's Focke-Wolf FW 190 of world war fame. The power plant is a Rolls-Royce "Nene".

Two days later a new high-speed jet fighter began its trial flight in Britain: the *Hawker P. 1081*, also powered with a Rolls-Royce "Nene". While the de Havilland "Venom" carried off a brilliant demonstration at the S.P.A.C. display at Farnborough last Autumn only four days after its initial flight, the P. 1081 duplicated that performance by streaking from London to Brussels in 21 minutes on its fourth day of flight and became the sensation of the Antwerp air meeting on its sixth day of operation.

Meanwhile, the *Blackburn & General Aircraft GAL-60* four-engined military transport, Britain's second-largest aeroplane (162-ft. span), started on its first flight on June 20th. The type is powered with four Bristol "Hercules" engines of about 2,000 h.p. each. Detailed technical information was published some time ago concerning its civilian opposite number, the "Universal Freighter". Gross weight, 100,000 lbs.; practical range, 1,750 miles with a payload of 13,100 lbs.; cruising speed, 173 m.p.h.; etc. It is not known if these figures also apply to the military version. If they do, they are top-secret again.

North American RB-45C

Added to the list of new aircraft must be three new versions of the *Gloster "Meteor"* twin-engined jet fighter: the "Meteor 9" is an armed single-seater reconnaissance fighter with a camera gun in the nose; the "Meteor 10" is unarmed, has an enlarged wing and carries photographic equipment for high-altitude reconnaissance (same nose as the "Meteor 9"); and the "Meteor 11" is a two-seater night-fighter with full radar equipment in the nose and belly.

The *North American B-45 "Tornado"* four-engined jet-propelled light bomber of the U.S.A.F. has now reached the stage at which well-proven aircraft—which perhaps have been found to be not entirely satisfactory for their original purpose—become the starting point for special versions. The North American RB-45C thus has become a high-level photographic reconnaissance aircraft. It differs from the original type by five cameras, some of which are housed in the re-designed nose. Gross weight is stated to be 110,000 lbs., operational radius 1,200 miles.

CRASHED DURING TESTS

Unfortunately the testing of new aircraft has not taken place without a heavy toll during the past month. On May 25th the prototype of the *Arsenal VG-90* naval jet fighter crashed in France when the landing gear became unlocked in the course of a high-speed run. The wheel well covers were carried away by the air stream and knocked the tail unit out of commission. Test Pilot Pierre Decroo lost his life.

For reasons unknown, experimental models of the *Lockheed F-94* all-weather jet fighter and of the *North American AJ-1* naval bomber crashed in the United States, killing their occupants.

A serious loss was suffered by the British aircraft industry through the crash of the world's largest helicopter, the *Cierva "Air Horse"*, which had nearly completed its flying trials. The accident, which claimed three victims, was provoked by fatigue fracture of a rotor drive shaft.

The most serious accident of them all occurred in France. On June 30th the SE 2010 "Armagnac" four-engined transport of SNCA du Sud-Est, described in detail two issues ago, unsuccessfully attempted an emergency landing directly after taking off from Toulouse-Blagnac. The aircraft burned up and two of the flight-engineers lost their lives. The other occupants were thrown out and excaped with injuries. The forced landing apparently had become necessary owing to a mechanic's inadvertent failure to lock a leading edge section in position before take-off. The prototype of the SE 2010 had accomplished 103 flights aggregating nearly 300 hours in the air. The second "Armagnac", which is the first of the production series, is nearing completion.

HEAVYWEIGHTS

Amongst the "older generation" of aircraft types, the *Boeing B-50 "Superfortress"* medium-heavy bomber and its counterpart, the C-97A "Stratofreighter" of the U.S. Air Force, have recently been in the news. During take-off tests the B-50 succeeded in getting off the ground at an all-up weight of 173,000 lbs., the C-97A at a weight of 174,000 lbs. The wing-loading of the "Stratofreighter" on this occasion therefore reached 99 lbs./sq.ft. Is this a record ?

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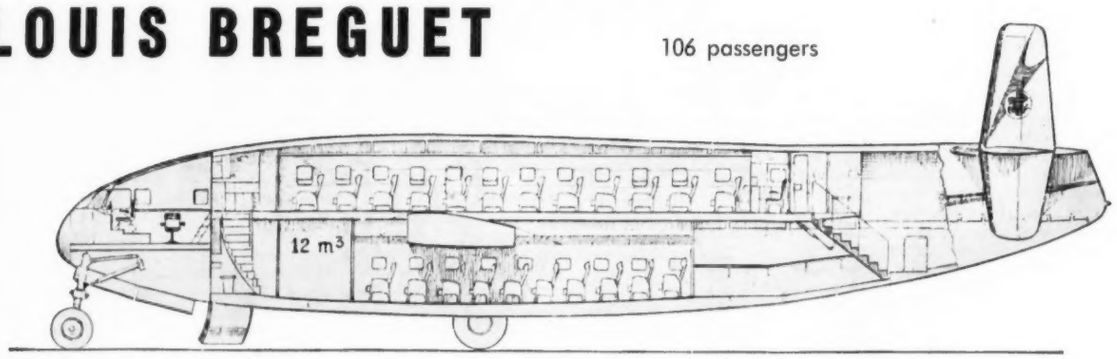

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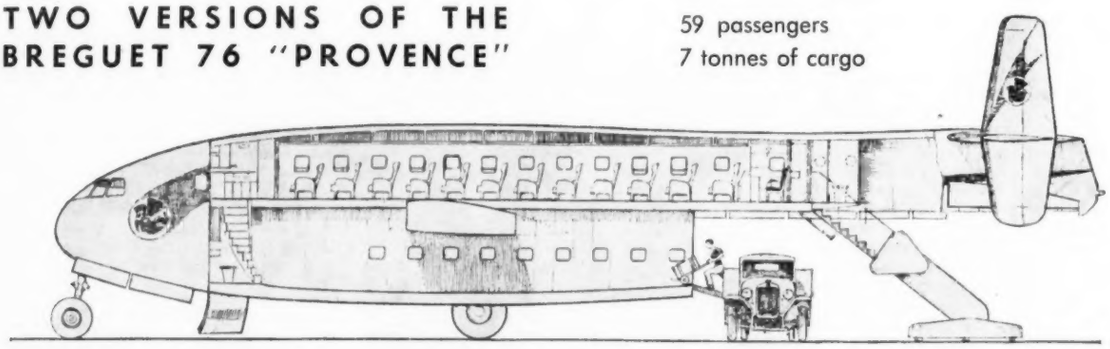

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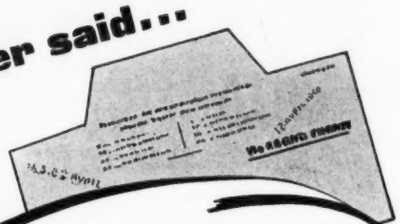

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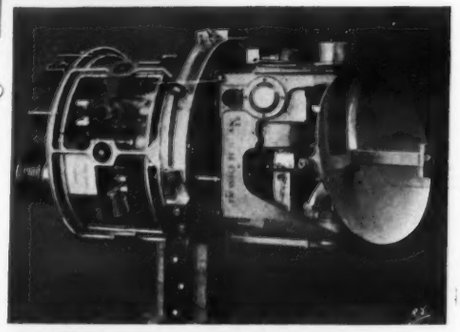

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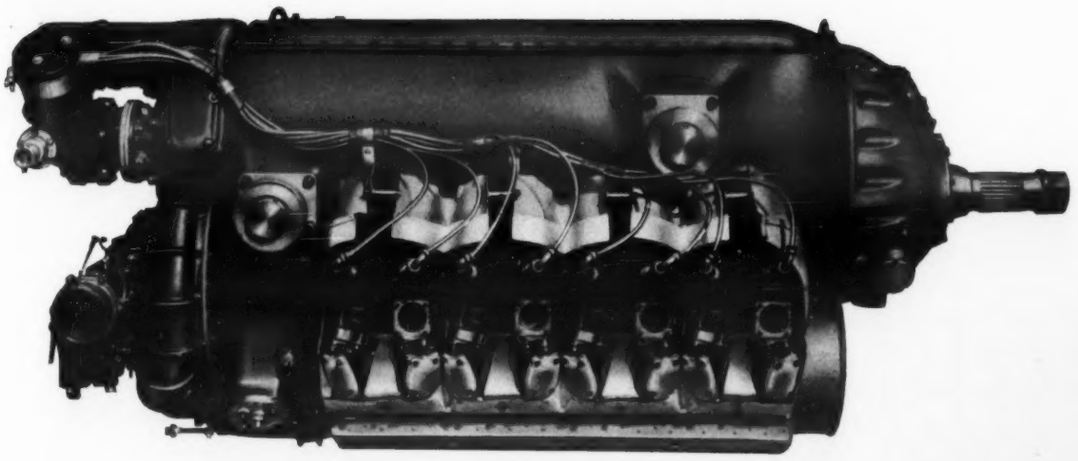

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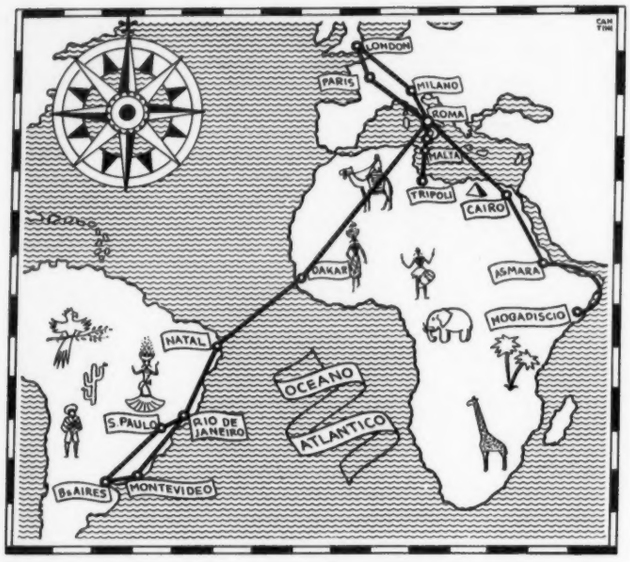

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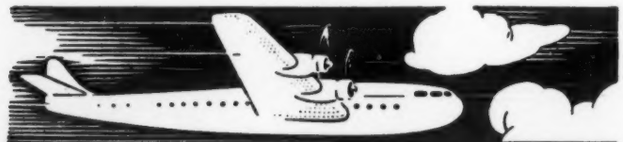

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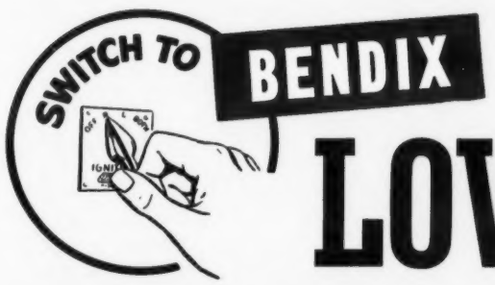

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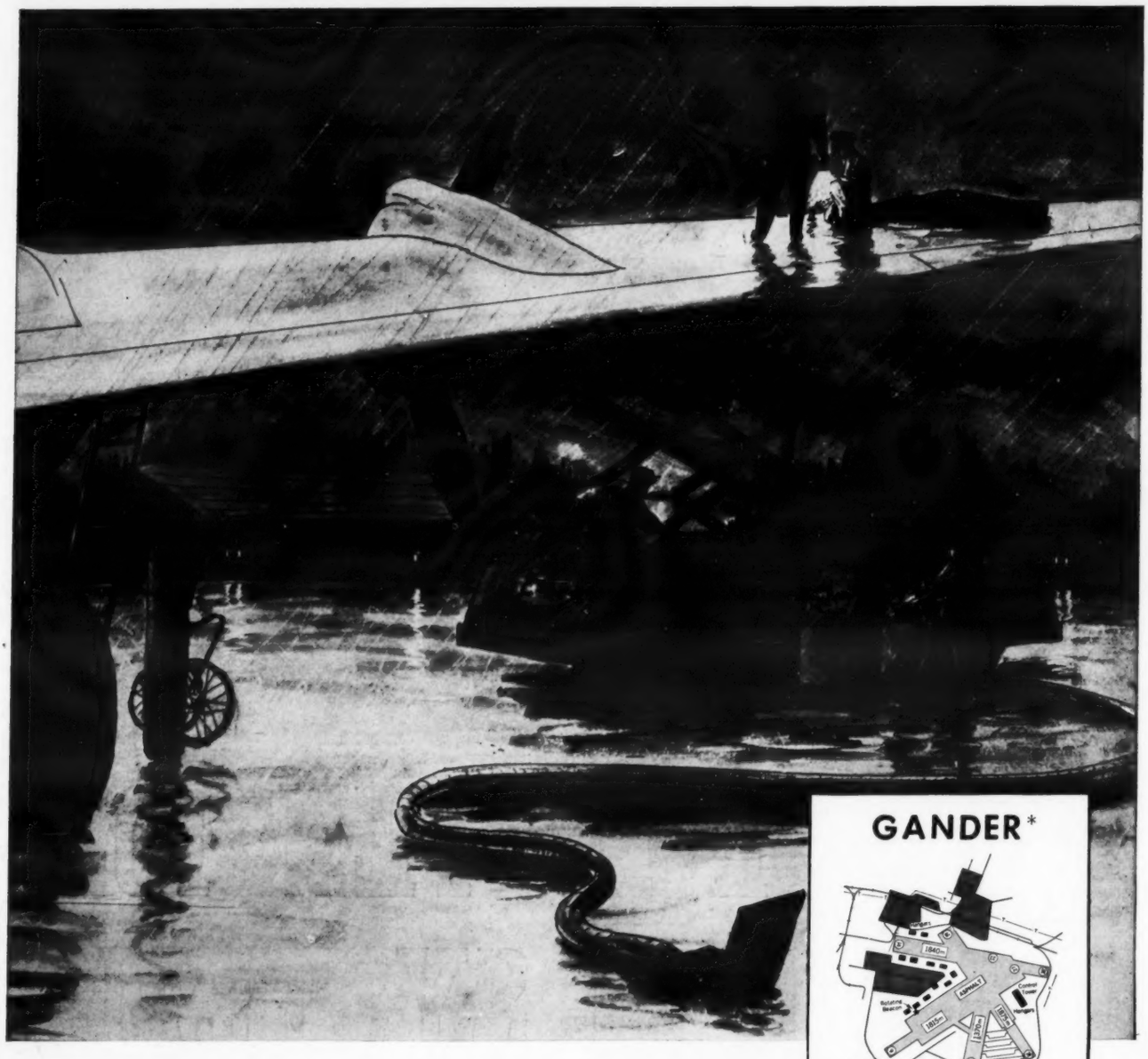

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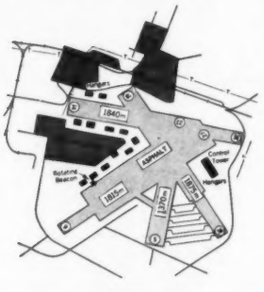

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